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June Dailies for Foreign Subscribers

If foreign subscribers to the Mechanical Edition of the Railway Age Gazette will advise us at once whether they wish to have the daily editions of the Railway Age Gazette, which are published during the Atlantic City conventions of the Master Car Builders' and Master Mechanics' Associations, we shall be glad to see that they are forwarded to them; otherwise, if they are not specially requested, they will not be mailed to them because of the very considerable expense involved. Subscribers in the United States, Canada and Mexico will, of course, be furnished with copies of the Dailies.

The Erie Triplex Locomotive

In the Triplex locomotive recently completed by the Baldwin Locomotive Works for the Erie is attained a new "largest locomotive." This engine not only exceeds in total weight the 2-10-10-2 type Mallet locomotives of the Santa Fe, but by the placing of a group of cylinders and driving wheels under the tender, a large proportion of the weight of the latter is made use of for adhesive purposes. There are many interesting features about the locomotive, but after a study of the machine there undoubtedly will be some doubts as to its practicability. However, this cry has been raised so many times and later proved to be without foundation that critics would do well to withhold comment. The locomotive has not yet been given a thorough service test and as it constitutes an entirely new departure in locomotive design, the service results will be awaited with interest.

May and June Conventions

Our next issue will be largely in the nature of a convention number, and will contain comprehensive reports of the Air Brake Association, which meets at the Hotel Pontchartrain, Detroit, Mich., May 5-8; the Railway Storekeepers' Association, which meets at the Hotel Raleigh, Washington, D. C., May 18-20; the International Railway Fuel Association, which meets at the Hotel La Salle, Chicago, May 18-21; and the Master Boiler Makers' Association, which meets at the Hotel Walton, Philadelphia, Pa., May 25-28. Announcements of the programs of these conventions will be found elsewhere in this issue. In each case the indications point to more than ordinarily successful meetings. Closely following these will come the mechanical department conventions at Atlantic City, the Master Car Builders' Association meeting, June 10-12, and the American Railway Master Mechanics' Association, June 15-17. Mechanical Edition subscribers in this country will, of course, receive the eight dailies which are issued during these two conventions.

The Draft Gear Competition

Remember that the draft gear competition, which was announced in the March and April issues, will close on May 15. It is surprising when we consider the importance of this subject that so many of the roads have given it so little careful and intelligent study. Many of them have introduced friction gears to a considerable extent and yet when called on for an exact statement of their advantages are unable to reply with any definiteness. Officers of other roads may give a good idea of the advantages as they see them in handling the cars on the repair track. Few of them, however, are able to cover the matter with any degree of satisfaction. Our aim in announcing this competition, realizing as we do the far-reaching importance of the subject, was to draw out and place on record as much as possible of the results which have thus far been demonstrated and ascertained from the use of the higher capacity draft gears. If you can contribute anything to this discussion, you may rest assured that it will be very thoroughly appreciated by the railroads throughout the country. A first prize of $100 will

be awarded to the contestant who can develop the best practical information concerning the most desirable type of draft gear. Articles which are accepted for publication, but which are not awarded the prize, will be paid for at our regular space rate.

Pennsylvania Superheater Tests

The testing plant at Altoona has again furnished an important contribution to the knowledge of locomotives gained by scientific study, in the tests of superheater performance recently completed there. The paper embodying the results of these tests and presented on April 30 before the Franklin Institute, Philadelphia, by C. D. Young, engineer of tests of the Pennsylvania Railroad, probably contains the most complete data on superheater performance yet available. While a number of definite conclusions are to be drawn from the results of these tests, probably that which will possess the most general interest is the confirmation of the widely-held belief that high-degree superheating is the most economical. We give in this issue only that portion of the paper pertaining to the tests and their results. The first part of the paper contained a most interesting and valuable collection of historical data on the subject of superheated steam for locomotives.

Conservation of Motive Power

An analysis of the movement of locomotives during the 24 hours of the day will show that they are in actual revenue service but a very small percentage of the time—usually from 15 to 20 per cent. It will also show that they are in the hands of the mechanical department most of the time—usually from 50 to 65 per cent. For economic reasons it is desirable to have locomotives in revenue service as much as possible, and were they in use twice as much as they now are, or from 30 to 40 per cent of the time, only one-half the present number would be required and the capital tied up in locomotives would be reduced 50 per cent. To make this saving requires the greatest amount of co-operation between the transportation department and the mechanical department. It should be the aim of the mechanical department to turn the engines as rapidly as possible at the terminals, having them ready for their next trip out in the shortest possible time. By doing this the question of superfluous power will be a matter of poor scheduling of the service, a matter which could easily be remedied. The saving of one locomotive would mean a saving in interest charges of $1,000 to $1,500 per year, showing that even the smallest increase in the revenue mileage of locomotives would be productive of a material ultimate saving. Many roads have found that the terminal inspection pit has been a large factor in reducing the turning of locomotives at terminals.

Pops and the Coal Pile

It has often been said that the subject of fuel economy is as old as the steam engine, but that does not prevent one from continually preaching it. The study of the economical use of fuel is most interesting, as there are so many ways in which it may be used to better advantage. Wasting fuel at the pops is worse than deliberately burning up money, for in the first case a man is working hard (shoveling coal) to no purpose, throwing away his energy and the company's money, while, as to the second case, the man who will burn up his money usually is in such circumstances that the loss to him is negligible. A 3½ in. pop blowing for a minute wastes about 20 lb. of coal, which with coal at $2 per ton is at the rate of $0.02 per minute. This may not seem large, even though it is more than twice the wages of the fireman, but if all the sixty odd thousand locomotives in this country were allowed to blow off one-half hour out of the twenty-four, $36,000 would be literally thrown away daily—which is at the rate of over 13 million dollars a year. The firemen are not always responsible for this waste. The engineer may, in numerous ways, help to avoid it. He should let his fireman know when he is about to shut off and can also greatly assist by operating the injector at the right time. The roundhouse men are also responsible for a certain amount of this waste. Anyone who is at all familiar with engine house practices knows how common it is to see locomotives which are awaiting the arrival of the crews, standing with the pops open a large percentage of the time. By carefully handling the fires while the engine is under their care they will help to prevent the engine throwing away good fuel via the pops. The men should be made to see that the elimination of such waste is the elimination of just so much work for them.

Competition on Engine House Work

Running repairs to locomotives are made under conditions which not infrequently require considerable ingenuity for their successful accomplishment. The increased sizes of locomotives within recent years and the bringing into general use of superheaters and other special devices have necessitated changes in engine house repair methods and in some cases the adoption of entirely new practices. Although it has taken some railway men a long time to realize what may be accomplished by adequate running repairs, there are now many railways on which the engine house more nearly obtains the recognition which it should have than has commonly been the case in the past. In order to show some of the best practices in modern engine house work a prize of $50 is offered for the best article on the handling of engine house work which is received before July 15, 1914. The article may deal with any phase of locomotive repairs which pertains to roundhouse work, such as organization of forces, injector and air brake repairs, handling of work reports, boiler inspection and repairs and boiler washing. A subject that may appeal to men who are located at outlying points is that of making heavy repairs where the machine tool equipment is inadequate. While such work, whenever possible, is done at the larger engine houses, it occasionally becomes necessary to turn out quite extensive work at a small terminal. These subjects are merely given as suggestions and competitors are at liberty to choose any subject which comes under the head of roundhouse work. The judges will base their decision on the practical utility of the suggestions which are made or the practices which are described. Space rates will be paid for articles which are accepted for publication but do not win the prize.

Locomotive Fuel Economy

Remarkable advances have been made in the economical use of fuel in locomotives since the publication in the American Engineer of April, 1908, of what was probably the first comprehensive and thorough published study on this subject. In the latter part of the same year, November 20, 1908, the International Railway Fuel Association was organized at Chicago with a membership of 35. Doubtless the above mentioned article may have been one of the principal sources of inspiration which brought about this development.

Everything connected with the operation of a locomotive or the movement of a train has some effect, direct or indirect, on the fuel consumption. The appreciation of this fact, more than any other factor, has undoubtedly been the cause of the increased responsibilities which have been placed upon the shoulders of many of the railway officers of that new class which has sprung into existence within the past few years, which is charged with securing more efficient use of the locomotive fuel. As an example of this, the practice on the St. Louis & San Francisco may be referred to. The head of the fuel department reports direct to the general manager and has the title of superintendent of locomotive performance. His assistants rank with the as-

sistant division superintendents and have equal authority. The department not only controls the handling and, to a certain extent, the loading of locomotives, but looks after their proper distribution over the system. This is because of the fact that fuel economy and efficient operation under ordinary conditions are practically synonymous.

With this in mind it is interesting to note from an article which appears in the current issue of the Railway Age Gazette just what is considered as the most vital point in the campaign for fuel economy that is now being carried on on the Frisco. Is it the compilation and enforcement of rules and regulations as to the detail and proper methods of using the fuel or handling the locomotives? No. What, then, is it? The whole campaign, which has proved tremendously successful up to the present time, is based on the fact that the average man is anxious to do his best and thus to protect his reputation and his home. If he makes mistakes it is more often due to the fact that he has not been properly instructed in his work, rather than to a desire on his part to be indifferent. To secure the best results from the engineman, therefore, requires a painstaking and thorough campaign of education which will reach each individual and inspire him to the proper performance of his duties. It requires even more than this. Human nature is such that an individual check must be kept on the performance of each man in order to follow his progress and make sure that he understands what is required of him, and thus to emphasize the necessity of his giving his best efforts to the work.

The method of checking the performance of each engineer and fireman as the assistant superintendent of locomotive performance rides the locomotive, and the way in which this information is used, are, therefore, worthy of careful consideration. If an engineer is marked "good" in the various operations in which he is concerned, including the handling of the reverse lever, throttle, brake valve, lubrication and injector, and in cooperating with the fireman and inspecting the locomotive, and this happens for three successive trips on which the assistant superintendent of locomotive performance accompanies him, then he is given a letter of commendation from his supervisors and the fact is noted on the personal record. If his record is not good in any of the above mentioned respects, then the assistant superintendent of locomotive performance coaches him carefully and consistently until his work shows marked improvement. The same thing is true of the work of the fireman; in riding the engine the assistant superintendent of locomotive performance makes a note of the condition of the fire, the average number of scoops of coal used per mile, the number of times the grates are shaken, the number of times the pops are opened, the handling of the injector, the attention to duties and the use of the blower. The result is that those in charge have available a record which gives a good idea of the ability and performance of each of the engineers and firemen in the organization, and the men realize it and do their best to improve their performance.

The Northern Pacific has also been doing some special educational work of quite a different nature among its enginemen for the past three years, with excellent results. A fuel instruction car has been fitted up, as was described in the Railway Age Gazette of May 1, and each of the engineers and firemen on the system is required to take a course of three lectures which is given in the car. The purpose of these lectures or demonstrations is to give these men an excellent and clear-cut idea of the theory of combustion and the necessity of using their brains in performing their work. The experiments are simple and easily understood. They appeal to the intelligence of the enginemen and have resulted in a marked improvement in the work of these men. Another important system, but covering a much smaller territory, has also placed a fuel instruction car in service within the past few weeks. Its equipment and the methods of instruction are quite different from those employed on the Northern Pacific and the results which follow its introduction will be watched with much interest.

NEW BOOKS

Tests of Metals at Watertown Arsenal. 144 pages. 5¾ in. by 9 in. Illustrated. Published by the Government Printing Office, Washington, D. C. Bound in cloth.

This book is a report of the tests of metals and other materials made with the United States testing machine at Watertown Arsenal, Massachusetts, during the fiscal year ended June 30, 1913. It contains a great deal of valuable information, considerable of which is arranged in tabular form, while a number of diagrams are included. Microphotographs of different metals are included in the illustrations and the half-tone work throughout is exceptionally good.

Car Interchange Manual. Bound in paper. 128 pages. Size 6 in. by 9 in. Published by J. D. MacAlpine, Cleveland, Ohio. Price, 50 cents; $4.50 per dozen; $30 per hundred.

This book includes an abstract of all the decisions rendered by the arbitration committee of the Master Car Builders' Association, from cases one to 943. It has been compiled by the publisher with the purpose of providing a ready and concise work of reference to the previous decisions of the arbitration committee. It is thoroughly indexed, and every effort has been made to abstract the cases as briefly as possible while conveying the meaning of the decisions. Abstracts of cases that are of little importance as precedents have usually been made shorter than those of important cases. By doing this it has been found possible to keep the book within the limits of a convenient size. The last decision, 943, was rendered in September, 1913. The last pages of the book contain price lists for repairs as adopted by the Master Car Builders' Association, and also reference tables that are of value to car men.

Coal Mining Practice in District VIII (Danville). By S. O. Andros. 47 pages. 6 in. by 9 in. Illustrated. Bound in paper. Published by the Department of Mining Engineering, University of Illinois. Copies may be obtained by addressing State Coal Mining Investigations, Urbana, Ill.

Illinois is producing 62 million tons of coal per year, more than one-eighth of all the bituminous coal mined in the United States. The safety of the miners and the efficiency of the mining methods employed in the state are therefore matters of national concern. The Department of Mining Engineering of the University of Illinois, the State Geological Survey, and the United States Bureau of Mines have co-operated during the past three years to study Illinois mining conditions. The information collected at 100 mines is published in district reports. In Bulletin No. 2 are discussed causes of accidents to miners in Vermilion and Edgar counties, loss of natural resources by wasteful methods of blasting and mining, use of steel and concrete as substitutes for timber in the mines and other phases of underground mining. The bulletin also contains a description of the methods of removing the overburden from a coal bed by steam-shovel, a system of mining which has been highly developed in this district.

The Engineering Index Annual for 1913. Compiled from the Engineering Index published monthly in the Engineering Magazine during 1913. 508 pages. 6½ in. by 9 in. Bound in cloth. Published by the Engineering Magazine Company, 140 Nassau street, New York. Price $2.

This volume of the Engineering Index is the twelfth since the work was first undertaken and the eighth since it assumed the annual form, giving a continuous index to the engineering and technical literature of the past 30 years. The classified system of arranging the items is followed in place of the strict alphabetic order of the earlier volumes. The book was placed on the market this year considerably earlier than has usually been the custom in the past, this being attained by a great deal of special effort. The list of publications and transactions reviewed has been carefully scruti-

nized and the standard materially raised during the past 12 months. These now include the proceedings of such institutions as the Institution of Mining Engineers and the Faraday Society. Careful thought has been given to the classification, to the assignment of articles to the different divisions of the classification to which they seem most logically to relate and to cross references under all other headings where anyone using the Index might make his first search. This book is of great value to anyone concerned in engineering work of any nature.

Applied Mechanics. By C. E. Fuller and W. A. Johnston, professors of Theoretical and Applied Mechanics, Massachusetts Institute of Technology, Boston, Mass. 380 pages, 6 in. by 9 in. Bound in cloth. Illustrated. Published by John Wiley & Sons, Inc., New York. Price $2.50.

This is the first volume of a series of books on applied mechanics that are to be written by the authors. It is written primarily for students who have had a preliminary training in the principles of mechanics, such as is given in a course of physics, and in the elements of mechanism. Volume I deals with statics and kinetics. It contains five chapters; the first is a general introduction; the second, on statics, includes a thorough discussion of forces; the third, on center of gravity, discusses both plane surfaces and solids; the fourth, on moment of inertia, is handled in a similar manner, and the fifth, on kinetics, including kinematics, work, power and energy, friction, kinetics of rigid bodies having plane motion only, and impact. This book is probably the most complete work written on these subjects, as the authors have had many years of successful experience in teaching applied mechanics, and fully appreciate what a student of this subject requires. It is evident from the way in which the book is written that the authors have taken advantage of their teaching experience, and as a result have presented a book that may be readily digested by the student. Efforts have been made to keep away from complicated expressions with a view to simplicity, and where it has been thought necessary, illustrative examples have been added to make the work more readily understood.

Good Engineering Literature. By Harwood Frost. 5 in. by 7½ in. 407 pages. Bound in cloth. Published by the author and distributed by the Chicago Book Company, 226 South La Salle street, Chicago. Price $1.

As is truly stated in the preface of this book, every engineer is, sooner or later, called on in the course of his professional duties to do some form of literary work. Then he finds that the ability to speak and write clearly and forcibly, to express his thoughts and understandings and to describe his work so that others will understand it, will prove one of the most valuable items in his mental equipment. It is for such engineers that this book has been prepared. It carries a sub-title, "What to Read and How to Write with Suggested Information on Allied Topics." This explains the general scope of the work. Its author claims that its purpose is fourfold: First, to impress the readers with the value and need of the command of good English. Second, to indicate something of the standards of good engineering literature and the kind of material that is most valuable to the engineer and show him how to collect and arrange this information and prepare it for publication. Third, to aid the engineer in selecting and reading his professional literature. And, fourth, to collect and preserve some of the information given in the writing and addresses of technical men on this subject. Mr. Frost was formerly editor of the engineering Digest and manager of the Engineering News Book Department, and thus fully appreciates the need of a book of this kind. With his fund of knowledge of this subject and understanding of the exact points wherein engineers in general lack this knowledge, he is eminently fitted for preparing the work of this kind, which is of real practical value.

COMMUNICATIONS

STRENGTH OF LOCOMOTIVE BOILERS

[Editor's Note.—Two criticisms have been received touching on the statement concerning the area to be used in calculating the strength of crown stays as given in connection with Fig. 3 on page 127 of the March, 1914, issue, in the article on the "Strength of Locomotive Boilers." The article states that the area at the crown sheet or lower end of the stay should not be considered. In the original copy of the article the author stated that the area supported at the crown sheet end should be the area considered. A difference of opinion arose regarding this statement and it was changed to read as shown on page 127. It was understood at the time that this change had the approval of the author; it appears, however, that this was not the case, and while there may still be differences of opinion as to which method should be followed, we are glad to make this correction.

A typographical error occurred on page 125 in the same article in connection with the formula $\frac{(1.13)^2}{D}$. The brackets should enclose the entire formula, which should read $\left(\frac{1.13}{D}\right)^2$

Some further criticisms of methods used in this article have been received from W. R. Van Housen, St. Paul, Minn. These criticisms with the author's replies are given below.]

St. Paul, Minn., March 21, 1914.

To the Editor:

Regarding the size of rivets to be used in calculating the strength of seams, a variation in the practice of different locomotive builders should be noted. The various works of the American Locomotive Company have followed the practice of drilling the hole 1/16 in. larger than the size of the rivets as given on the drawings. The Baldwin Locomotive Works have always drilled the hole the size shown on the drawings, the cold rivet being 1/16 in. less in diameter.

The tell-tale hole in the outer end of the firebox staybolts should not be disregarded, as Mr. Allman states, for the reason that a 3/16 in. hole amounts to .0276 sq. in. area, and if considered, the stress will be considerably higher. The outer end of the bolt is where the fracture invariably takes place.

The statement that the ultimate strength of steel plates is based on a stress of 55,000 lb. per sq. in. where actual figures are available is misleading. The government allows the use of actual test figures where available. Standard specifications for boiler steel plate call for a tensile strength of from 55,000 to 65,000 lb. per sq. in. The plate in question might come within these limits, or it might have been found to be either higher or lower and still for some reason have been used in the construction of the boiler. In any case where the test figures are available, they are to be used.

In calculating the area of the unsupported portion of the backhead and front tube sheet, an arbitrary allowance of any fixed distance is open to criticism, as it allows no variation for different boiler pressures or thicknesses of plate. A method which makes allowance for both of these variable quantities is given in Peabody & Miller's "Steam Boilers," and agrees with the Master Mechanics' Association formula of 1895.

It is permissible to consider the area supported by a firebox staybolt as equal to the square of the pitch providing the stays are equally spaced each way. On many boilers this is not the case, and the area is then the product of the horizontal pitch multiplied by the vertical pitch. In all cases the area should be measured on the inside of the firebox.

I disagree with the method of calculating girder stays or crown bars. A fiber stress of 17,000 lb., as assumed, would give a factor of safety of only 2.65 in the crown bar. Prof.

Unwin in his Elements of Machine Design, Part I, gives a more rational method. Briefly, his conclusions are that for a crown bar with two braces to the roof sheet, one-quarter of its load is carried by each foot resting on the side sheet and one-quarter is taken to the roof sheet by each brace. In the case of a bar with four braces the load would be one-sixth for each. The rivets which hold the braces to the roof sheet are the ones meant by "crown bar rivets, top" on Form No. 4 of the Interstate Commerce Commission. W. R. VAN HOUSEN.

BALTIMORE, Md., April 9, 1914.

TO THE EDITOR:

Replying to the criticisms of Mr. Van Housen:

Regarding the size of rivets, the article does not go into details concerning the practice of the different manufacturers of boilers. The practice of the American Locomotive Company and the Baldwin Locomotive Works in indicating the size of rivets on their drawings, with which I am familiar, does not have anything to do with the article, as I have called attention to the fact that the size of hole is generally considered to be 1/16 in. larger than the initial size of the rivet, although some practices recently adopted have reduced this to 1/32 in. It would, therefore, be necessary in calculating the efficiencies to use the practice in vogue.

The point raised about the omission of tell-tale holes is questionable. The area of a 3/16 in. hole is so small as compared with the whole bolt, that it is disregarded; in fact, I have never previously known the question to be raised regarding this point. In figures which I have gone over, and which were worked up by two of our largest locomotive builders, the holes were disregarded.

Considering the ultimate tensile strength of the steel plates, I am aware that actual figures can be used when they are available; also that standard specifications for boiler plate as made out by various railroads and other manufacturers employ figures between 55,000 and 65,000 lb. per sq. in. Further, when actual figures are not available, the government requires a tensile strength of 50,000 lb. to be used for steel plates and 45,000 lb. for iron plates. The statement made in the article of 55,000 lb. per square inch as the basis for calculation, is for a matter of uniformity, and while actual figures can be used I do not consider this a matter of great importance, as when a boiler is designed for a certain factor of safety, the designer does not base his calculations on the highest tensile strength allowed under the specifications; on the contrary, he generally uses the minimum, and in my experience I find that the vast majority of the plates run much nearer the minimum specified than the maximum.

The criticism regarding the unsupported area of the back head and tube sheet is open for argument. In fact, there are so many views on this, that I would not like to say positively that Mr. Van Housen was correct or incorrect. The method I have given is one used more generally I believe. Mr. Van Housen quotes an authority (Peabody and Miller's "Steam Boilers"), which is very good. I stated in the article that there is a diversity of opinion concerning the area to be considered as unsupported, particularly on the front tube sheet. I have given a method that is approved by the different state boiler commissions, as well as insurance and casualty companies, and believe it is as nearly correct as any and will give results that are satisfactory.

I am aware that the area supported by the firebox staybolt is variable, and I believe that all who have anything to do with boilers, when calculating the streets, do not take one or more bolts without giving consideration to the entire area to be supported. When the pitch varies of course the entire area should be taken as a unit and not the area supported by any one stay taken at random. The area should be taken on the water side of the firebox, and not on the wrapper sheet.

Mr. Van Housen's claim that the method of calculating the stress on girder stays is incorrect, is a rather broad statement and I do not agree with him. I believe he is wrong concerning the fiber stress of 17,000 lb., and he further states that there is only a factor of safety of 2.65, which is not correct. This formula is based on a beam uniformly loaded, supported at the ends; that is, the girders are figured to carry a fiber stress of 17,000 lb., allowing the remaining load to come on the slings connected to the roof of the boiler. In other words, before any load could be transmitted to the slings there would be some deflection in the girder, otherwise, there would be no stress in the slings. The stress of 17,000 lb. is used as a maximum to be allowed in the girder and all above this transmitted to the sling. Of course, when a girder is not supported at the ends, the entire load on the crown sheet would be transmitted through the sling stays. WM. N. ALLMAN.

QUESTIONS FOR CAR DESIGNERS

PHILADELPHIA, Pa., April 4, 1914.

TO THE EDITOR:

I would like to know the proper method for calculating the bending moment at the corners of the open frame indicated in the accompanying sketch. In the American Engineer, November, 1909, page 434, there is an interesting analysis of the stresses that occur in a steel baggage car, having two door openings on the side. In this particular instance, there is a downward shear on the right hand side of the door opening, and an up-upward shear on the left hand side. These two shears consti-

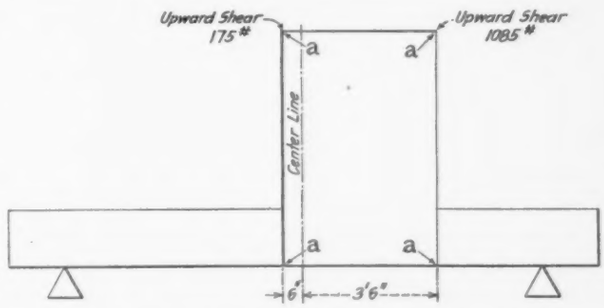


Diagram Showing Stresses at the Sides of the Opening

tute a couple, and the bending moment at the corners can readily be determined; but in the structure represented in the sketch there is on the left hand side of the opening an upward shear of 175 lb., and on the right hand side of the opening an upward shear of 1,085 lb., due to the frame being out of the center of the structure.

Again, if the open frame were in such a position, and the loading were such as to give an upward shear on one side of 500 lb., and a downward shear on the other side of 1,000 lb., how should the bending moments be calculated at the corners?

W. R. N.

TURNING EFFORT OF LEHIGH VALLEY LOCOMOTIVE

RIDGEWOOD, N. J., April 10, 1914.

TO THE EDITOR:

Referring to the article in the March issue of the Railway Age Gazette, Mechanical Edition, describing a Pacific type locomotive, built by the Lehigh Valley, the writer was very much interested in the assertion that the excellent performance of this locomotive is due in large measure to a supposed refinement in the valve gear and valve setting; the remarkable curve of turning effort shown would seem to bear out this statement. A close examination of the drawing, however, does not reveal any radical departure from ordinary practice in the arrangement or application of the Walschaert gear; the valve setting also is identical with present-day practice for high speed passenger

locomotives, with the possible exception of a somewhat longer steam lap.

Being at a loss to account for the extraordinary smoothness of the turning moment curve, the writer determined to investigate the shape of curve that might reasonably be expected from this locomotive. For this purpose the theoretical indicator diagram, Fig. 1, was prepared, to represent the card that this engine would give a speed of 148 r. p. m., or about 34 miles an hour. At this speed the cylinders should develop

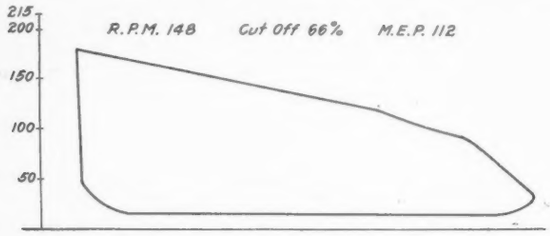


Fig. 1—Theoretical Indicator Diagram

2,300 h. p., assuming that the boiler is capable of furnishing the steam. The horse power is determined by the equation, $\text{H. P.} = \frac{\text{T. P.} \times \text{S} \times \text{C}}{375}$. As this engine has a nominal tractive effort at starting of 41,600 lb., the $\text{H. P.} = \frac{41{,}600 \times 34 \times .61}{375}$ = 2,300. The constant C, for 148 rev. is taken from the bulletin on "Locomotive Ratios" recently issued by the American Locomotive Company. The theoretical card is based on a cut-off of 66 per cent. The drop in pressure at cut-off and the amount of back pressure follow closely similar cards from tests of superheater locomotives on the Pennsylvania Railroad testing plant and tests made in road service. By integration it will be found that this diagram gives a mean effective pressure of 112 lb., or the amount required to produce 2,300 h. p. The normal tractive effort at 34 m. p. h. is 41,600 × .61 = 25,375 lb.

From the theoretical indicator diagram, the curve of turning moment, Fig. 2, was derived, by the method described in G. R. Henderson's "Locomotive Operation," the ordinates representing the successive positions of the crank in one complete revolution of the driving wheels; the abscissae representing the rotating force in pounds, considering the crank arm as unity. The heavy line is the final curve of rotating effort and is the algebraic sum of the steam and inertia forces acting at the crank pin. It will be observed that there is a difference of 47,000 lb. between the minimum and maximum rotating forces, in terms of tractive effort. This represents at the maximum point $\frac{90{,}000 \times 28}{77}$ = 32,700 lb., and at the minimum $\frac{47{,}000 \times 28}{77}$ = 17,100 lb. The average rotating force of 69,060 lb. corresponds to a tractive effort of $\frac{69{,}060 \times 28}{77}$ = 25,150 lb., which checks closely the figure given above.

We must therefore conclude that it is impossible with any type of valve gear or valve setting to produce the curve as illustrated for the Lehigh Valley engine.

In a paper on "The Three Cylinder Engine," delivered by J. Snowden Bell before the Master Mechanics' convention last year, the superiority in turning moment of the three cylinder engine over an equivalent two cylinder engine is discussed and diagrams similar to the above are given, showing characteristic turning moment curves for both types of engines.

H. S. VINCENT.

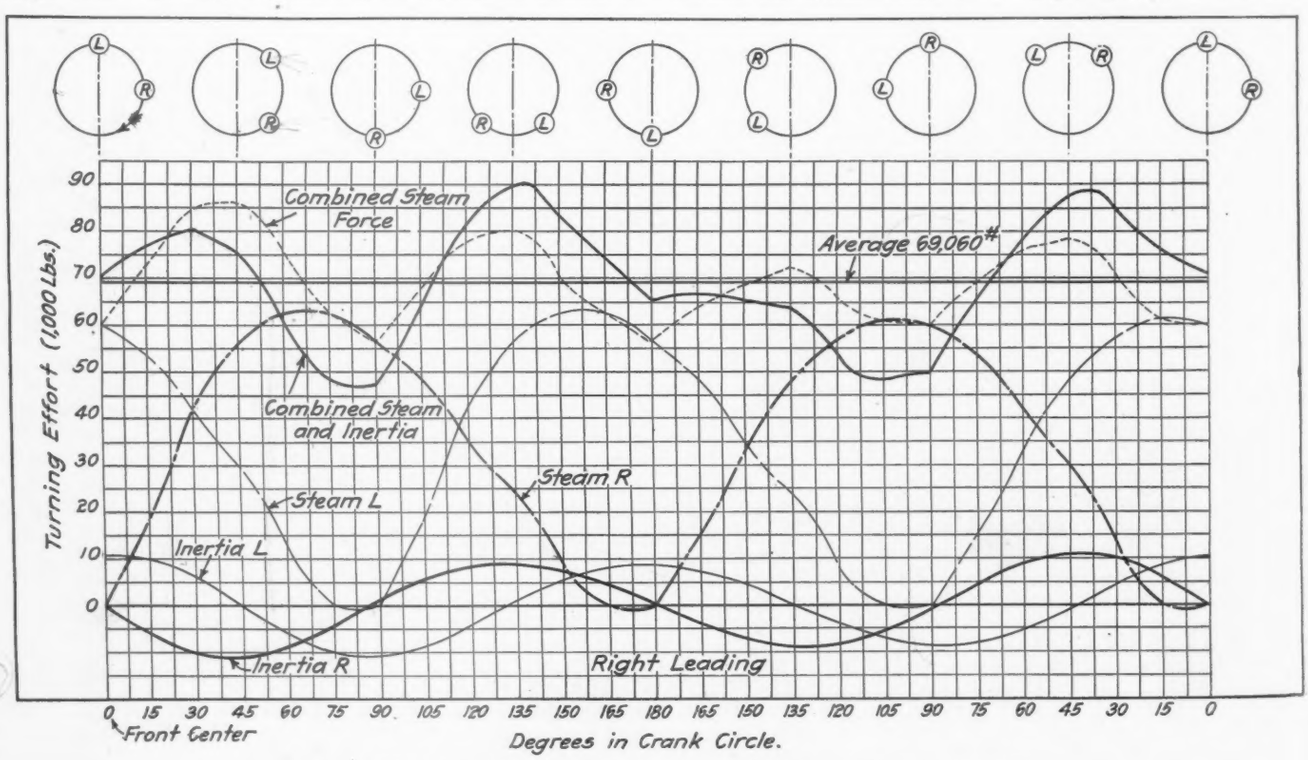


Fig. 2—Curve of Turning Moment for Lehigh Valley Pacific Type Locomotive

STEAM TURBINES IN STOCKHOLM.—Two of the most recent types of Oerlikon steam turbines are now running in the central electric station of Stockholm, these being of 10,000 h. p. Turbine and dynamo make up a compact group, and the turbines are of a new design, which is claimed to have a number of advantages, one of these being a steam consumption of 7.9 lb. per h. p. hour. The turbines operate at 3,000 r. p. m. standard speed. Such turbines are made up as usual of blade wheels, each in a separate steam chamber, but the combination of speeds and pressures within the turbine is based on a somewhat novel theoretical design.—*Power.*

TRIPLEX LOCOMOTIVE FOR THE ERIE

Largest in Total Weight and Theoretical Tractive Effort; Tender Weight Used for Adhesion

BY R. S. MOUNCE

[WITH AN INSET]

The Baldwin Locomotive Works have just completed a new type of articulated locomotive for the Erie Railroad which marks a distinct step in locomotive construction. It is called the Triplex Compound or "Centipede" type, and, as the name implies, goes beyond the well-known Mallet articulated type by the addition of another pair of cylinders and another group of driving wheels, making three complete engines in one locomotive unit.

The principle of compounding, which involves the use of two high pressure and four low pressure cylinders, originated with and is patented by G. R. Henderson, consulting engineer of the Baldwin Locomotive Works. The design was prepared by that company and incorporates ideas suggested by Wm. Schlafge, general mechanical superintendent of the Erie, who co-operated with them in the various details.

This locomotive is the largest and most powerful ever constructed. The Santa Fe 2-10-10-2 Mallets*—converted from 2-10-2 freight locomotives—which have up to the present been the heaviest, have a total weight, engine and tender loaded, of 850,000 lb. as against 853,050 lb. for the Erie Triplex. The most powerful locomotives on record, previous to this time, were the Virginian 2-8-8-2 Mallet.† These locomotives have a theoretical tractive effort, working compound, of 115,000 lb. as compared with 160,000 lb. for the Triplex.

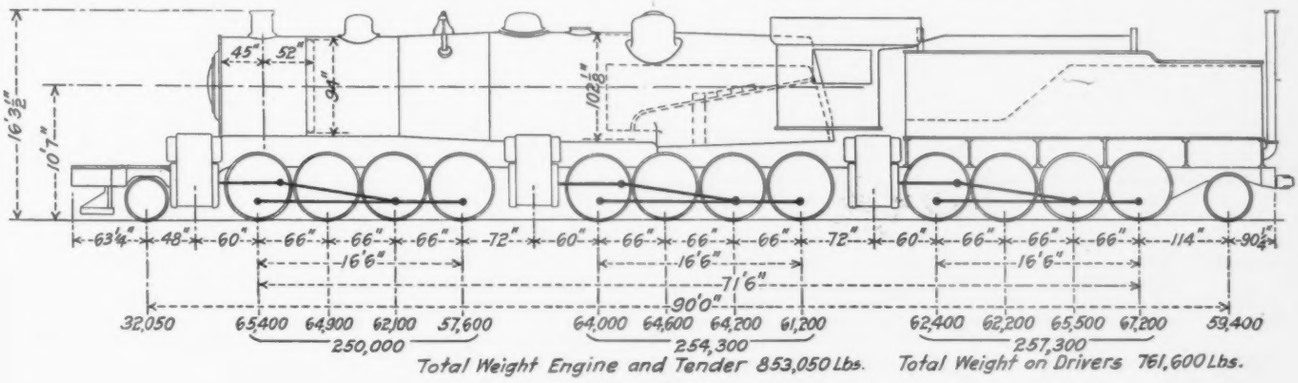


Diagram of Wheel Base and Weights

The new locomotive is to be used for pusher service on the eight mile grade east of Susquehanna, Pa., which averages 56 ft. to the mile. Full tonnage trains are now handled over this portion of the main line by a Consolidation lead locomotive with two Consolidations and a Mallet as pushers. The Triplex Compound has a tractive effort equal to the combined tractive effort of the three pushers now used. The capacity of this locomotive is not obtained by using excessive wheel loads or an unusually long wheel base, but is secured by placing the third engine under the tender, thereby taking advantage of a very large weight for adhesion which has heretofore been a dead load requiring considerable power to haul, especially on heavy grades. The wheel arrangement is 2-8-8-8-2 and the total wheel base is 90 ft. The locomotive will operate over curves up to and including 16 deg.

All of the cylinders are equal in size, having a diameter of 36 in. and a stroke of 32 in. Two cylinders are high pressure and four low pressure, the high pressure pair driving the middle group of wheels. The right high pressure cylinder exhausts into a receiver which supplies the front pair of low pressure cylinders, and the left high pressure supplies the rear pair in a similar manner. This gives a volume ratio of one to two.

*For description of Santa Fe 2-10-10-2 Mallet locomotives see American Engineer and Railroad Journal, May, 1911, page 171.

†For description of these locomotives see American Engineer, June, 1912, page 287.

BOILER

The boiler has unusually large proportions, exceeding in some respects, especially in its heating surfaces, that applied to the Virginian Mallet type locomotive previously mentioned. The barrel has one conical course. At the front end it measures 94 in. in diameter and at the dome ring 102⅛ in. The circumferential seams are triple riveted; the longitudinal seams have sextuple riveted butt joints welded at the ends, and have an efficiency of 90 per cent. Since the firebox is set over three pairs of 63 in. diameter driving wheels, the throat sheet is quite shallow.

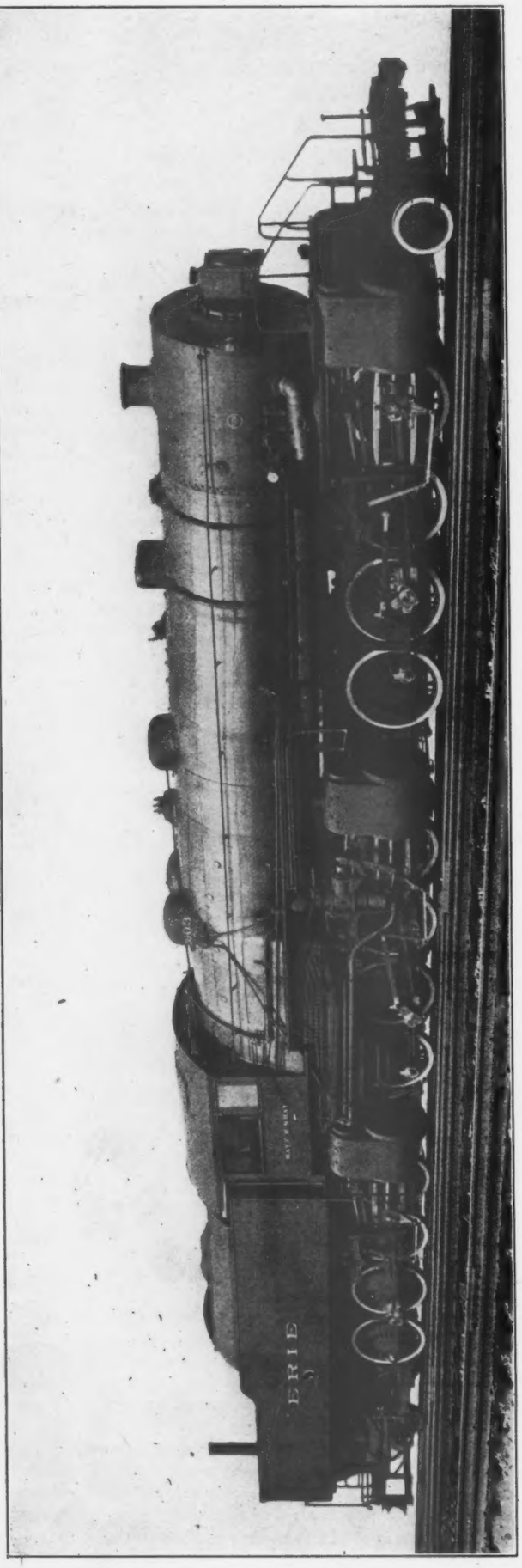
There are 326-2¼ in. tubes and 53-5½ in. superheater flues, 24 ft. long. In order to keep this length within the limits of good practice a combustion chamber 54 in. long is used.

Clearance limits required a very short dome, which is of pressed steel 33 in. in diameter and 13 in. high. In this a Chambers throttle valve is fitted, and is connected to an inside dry pipe in the usual manner. The safety valves are mounted on a steel casting, which is but slightly higher than the boiler shell. Instead of one large sand box on top of the boiler, there are two comparatively small ones. Two sets of top boiler check valves are used, one for the injectors and the other for the hot water pumps, which will be described later.

The firebox is of the radial stayed type, with a full installation of Tate flexible bolts. It is 162 in. long and 108 in. wide at the mud ring. The grates extend forward 120 in. to the point where a Gaines brick wall separates the fire space from the combustion space. The brick arch is supported by six 3½ in. arch tubes, and is supplemented by the brick wall through which heated air is delivered by seven 3 in. pipes, placed vertically in it. The fire doors are of the Franklin vertical type, two in number, placed 32½ in. between centers. The locomotive will be fired by a Street mechanical stoker.

The Schmidt superheated is the largest ever applied to a locomotive, having 53 elements and 1,584 sq. ft. of superheating surface. The header is divided, separate castings being provided for the saturated and the superheated steam.

The front end contains a single exhaust nozzle with a ring type blower. The nozzle is rectangular in shape, and is adjustable, longitudinally, by means of a pair of deflectors mounted on square shafts which are operated from the outside of the smoke box by a right and left hand screw connected to arms on the square shafts. The operating device is located just ahead



Triplex Locomotive Built for the Erie Railroad by the Baldwin Locomotive Works

of the superheater damper regulator. The nozzle may be varied from about seven by nine inches to seven by three inches. The smoke stack is 22 in. in diameter.

STEAM PIPES, CYLINDERS, VALVES AND VALVE GEAR

Steam passes from the superheater to the high pressure cylinders through outside steam pipes, which are fitted with a ball joint and a sliding joint. The high pressure cylinder saddle has two passages cored in it, one leading from the right exhaust chamber to the front receiver pipe, and the other from the left exhaust chamber to the rear receiver pipe. These receiver pipes are flexible, having the usual ball and sliding joints. They convey the high pressure exhaust to the two sets of low pressure cylinders. The front low pressure cylinders exhaust to the stack in the usual manner, through a flexible pipe, whereas the rear low pressure exhaust is carried back the full length of the tender, and is discharged through a vertical pipe at the back end of the tank. Between these cylinders and the exhaust pipe is a feed water heater, which will be described later.

The cylinders are separate from their respective saddles, and are all cast from the same pattern. Cylinders and valve chambers are fitted with Hunt Spiller metal bushings.

The main valves are all 16 in. in diameter, arranged for inside admission, and are driven by the Baker valve gear.

The three sets of valve gear are controlled simultaneously by the Ragonnet power reverse gear. The reverse shaft for the high pressure engine is located just back of the high pressure cylinders, that for the front engine immediately ahead of the same cylinders, and that for the rear engine directly back of the rear cylinders. These shafts are connected by flexible reach rods, the front one passing through the high pressure cylinder saddle, and the rear one through the ash pan and rear cylinder saddle, guides being provided in the saddles and the flexible joint arranged in the form of a rod and crosshead.

TENDER AND FRAMES

The arrangement of the tender section of the Triplex is, in many respects, very similar to that of an ordinary steam locomotive. The frames, wheels, driving gear and spring rigging are very much the same as those on the other two sections. The tank is supported on the frames by six cast steel bearers, which act as transverse frame braces as well.

The frames are vanadium steel castings, six inches thick, and, with the exception of those in the tender section, each frame is in one piece, the front portions being a single slab to which the cylinders and saddles are securely bolted and keyed. The rear frames differ from the other four in that they are each in two pieces, the construction usually employed with outside bearing trailing trucks having been followed.

The articulated connection between the middle and front frames gives flexibility both vertically and horizontally. The radius bar is attached to the front frames by a horizontal pin, which provides for the vertical movement. It makes a ball joint connection with the hinge pin under the high pressure saddle. The connection between the middle and rear frames is placed under the cab. It is similar to the other connection, except that the radius bar is rigidly attached to the middle frames, and obtains its flexibility from the ball jointed arrangement at the hinge pin under the rear cylinder saddle.

The spring equalization is arranged as follows:

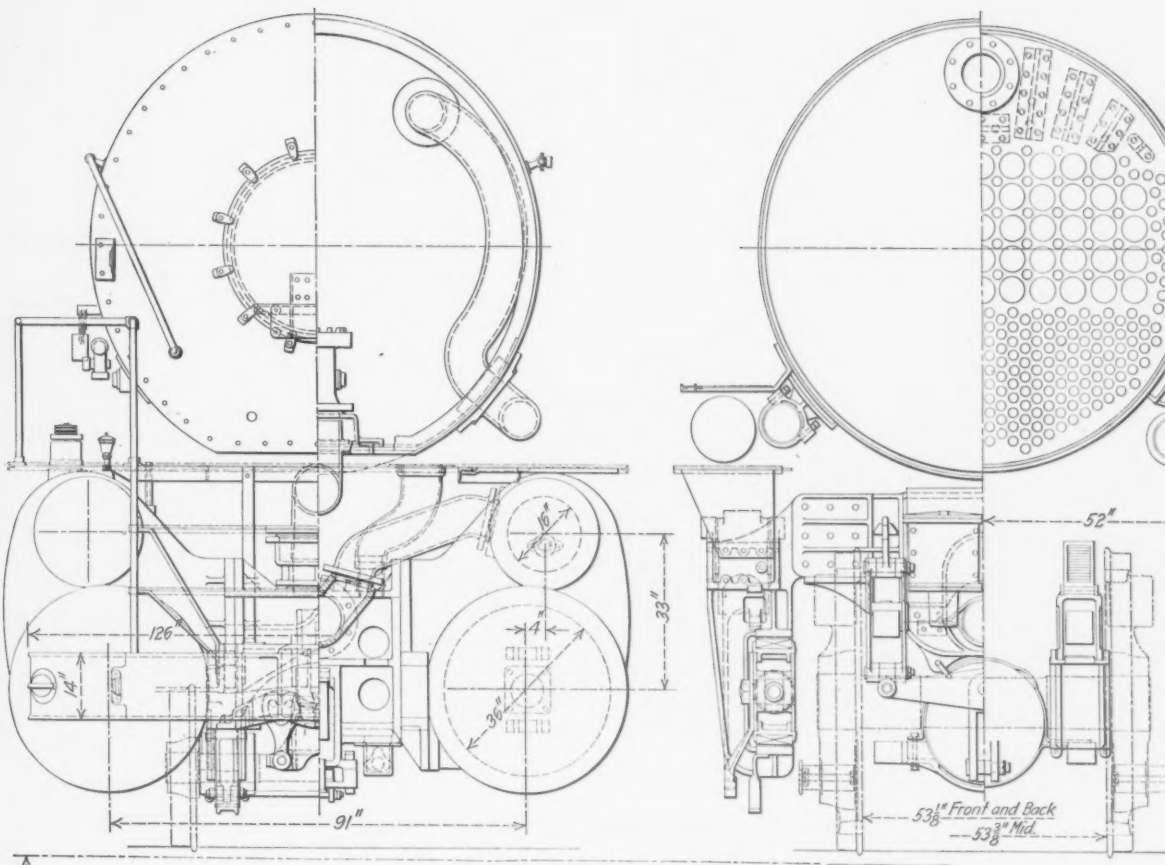
First engine—The engine truck being of the center bearing type, the equalization is continuous, and the arrangement is like that generally used on Consolidation locomotives.

Second engine—The equalization is continuous on each side without cross connection.

Third engine—The first and second drivers are equalized together, each side independently of the other. The third and fourth drivers are equalized with the trailing truck.

FEED WATER HEATER, HOT WATER PUMPS AND INJECTORS

The Triplex locomotive, in addition to its many unusual constructive features, has a novel system of feed water heating and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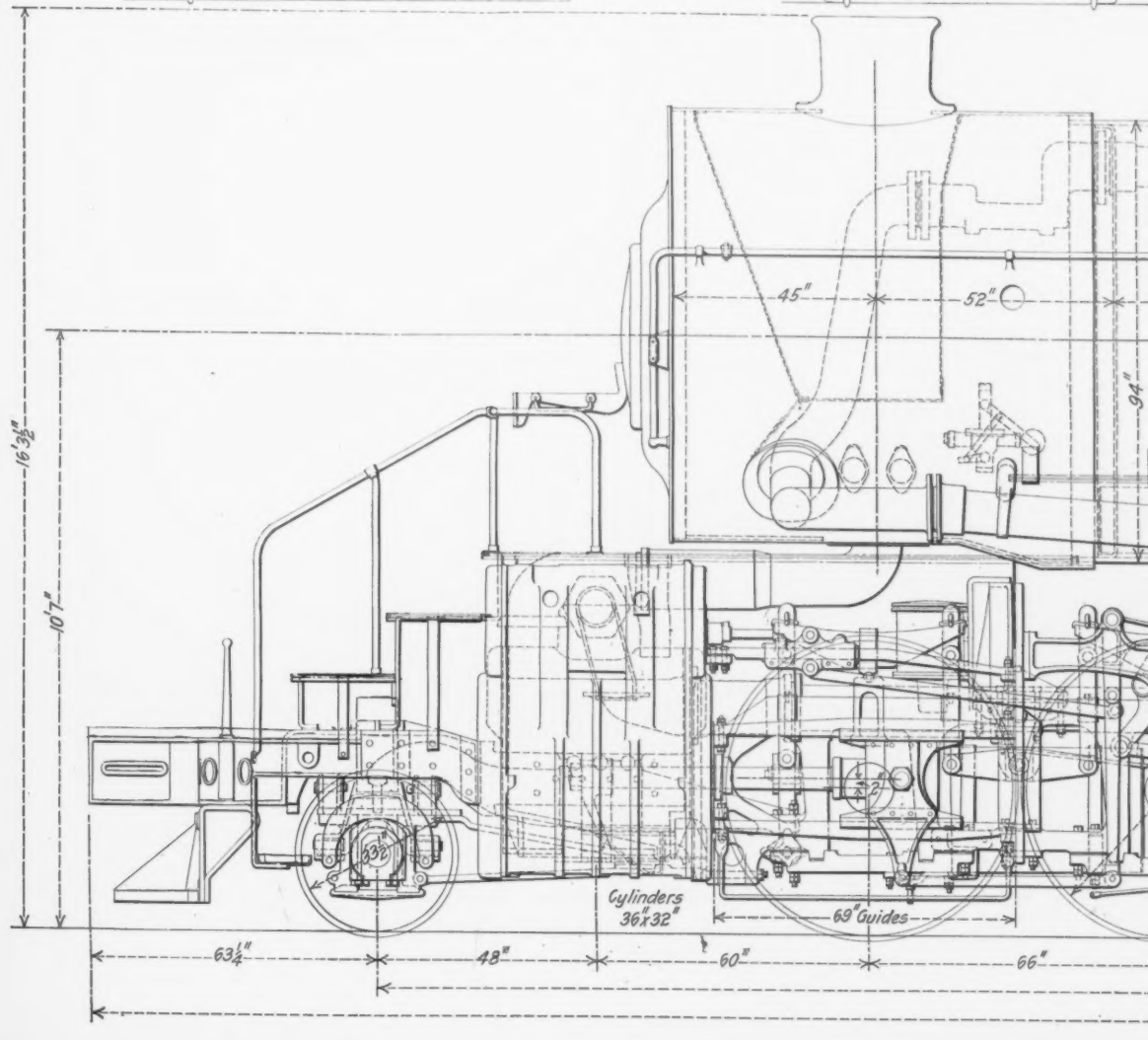
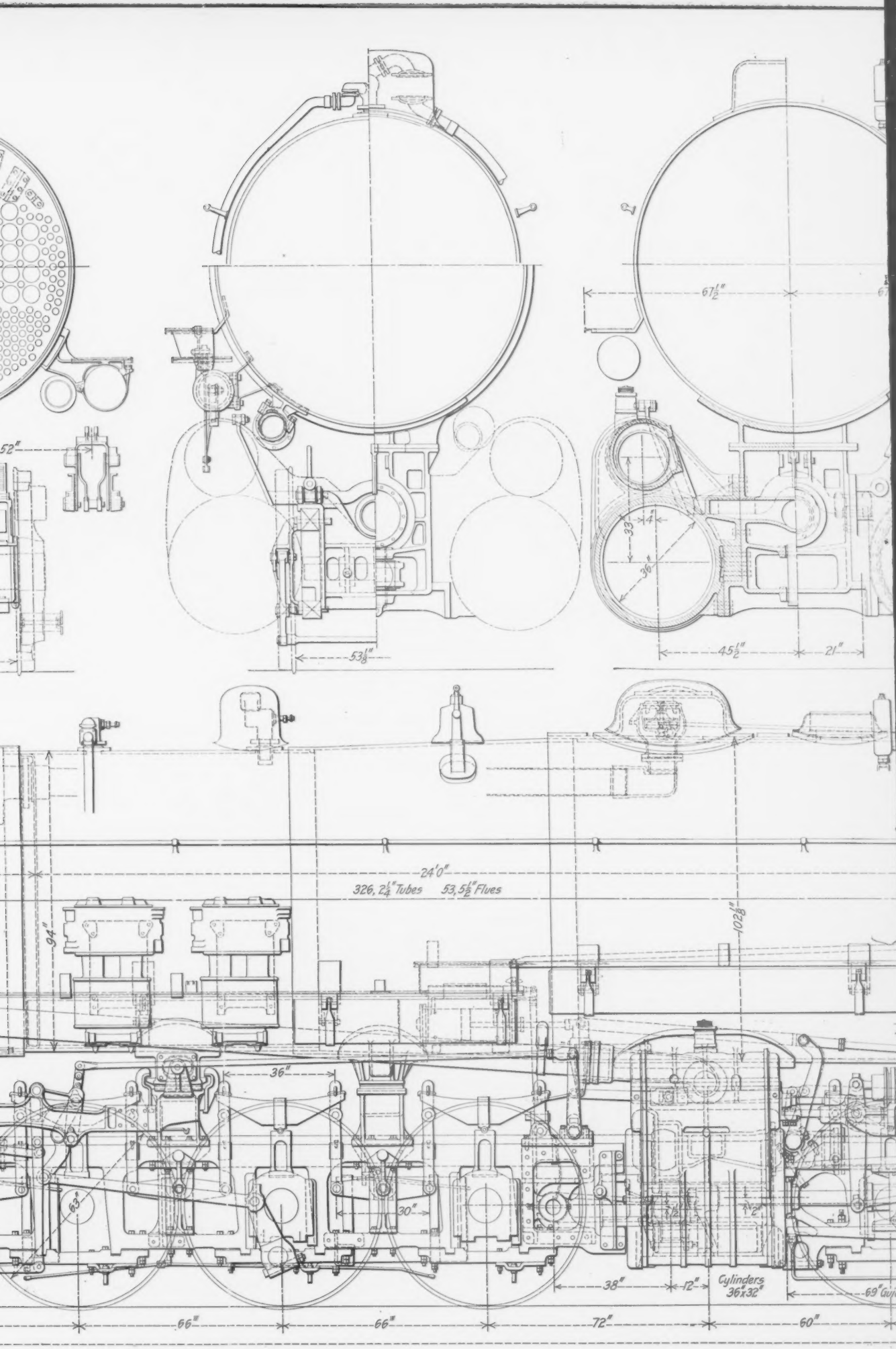
14"
91"
4"
36"
33"
52"
53 1/8" Front and Back
53 3/8" Mid.


16'3½"
10'7"
45"
52"
94"
33"
Cylinders
36"x32"
69" Guides
63¼"
48"
60"
66"


67½"
53⅛"
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21"
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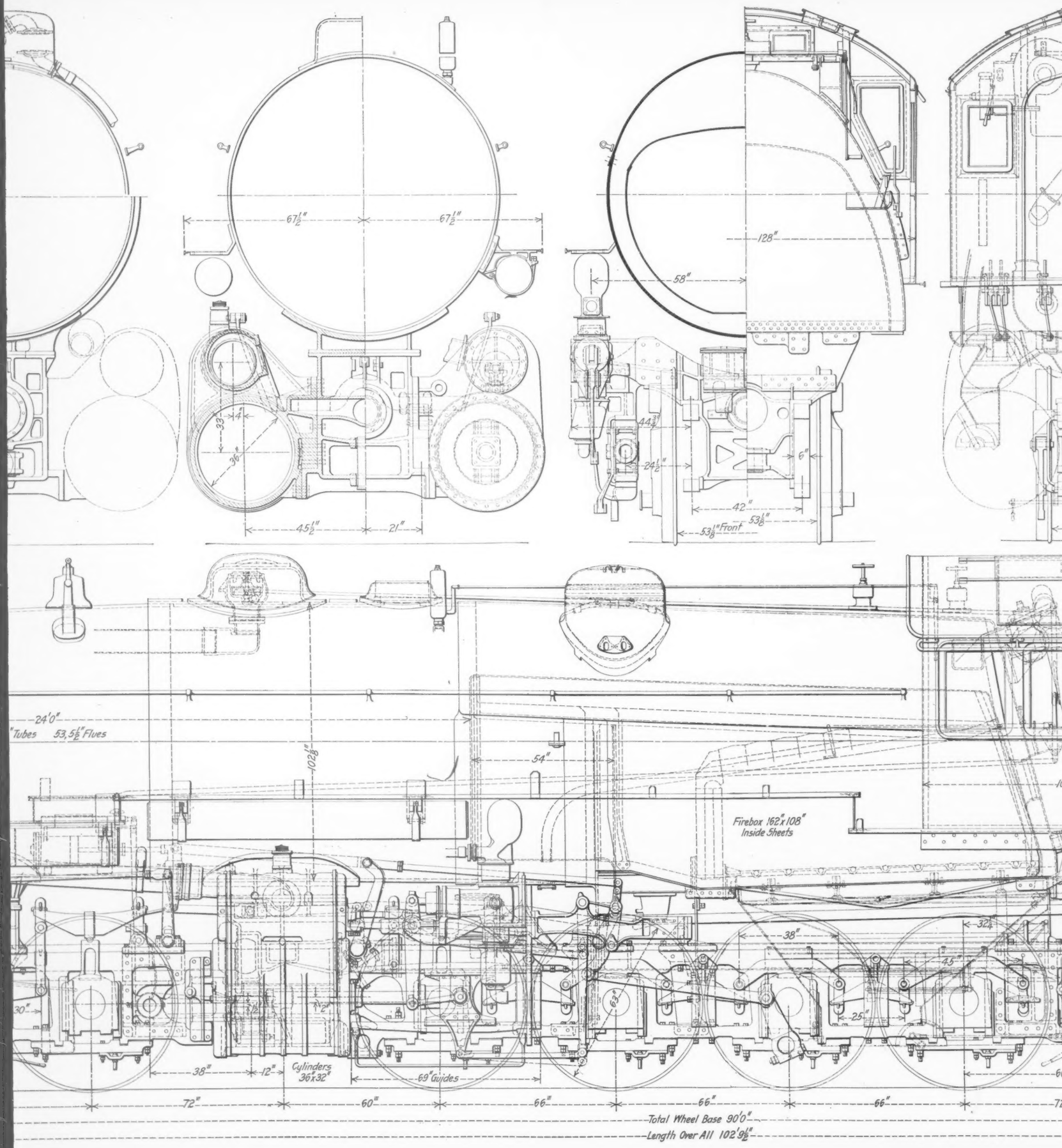
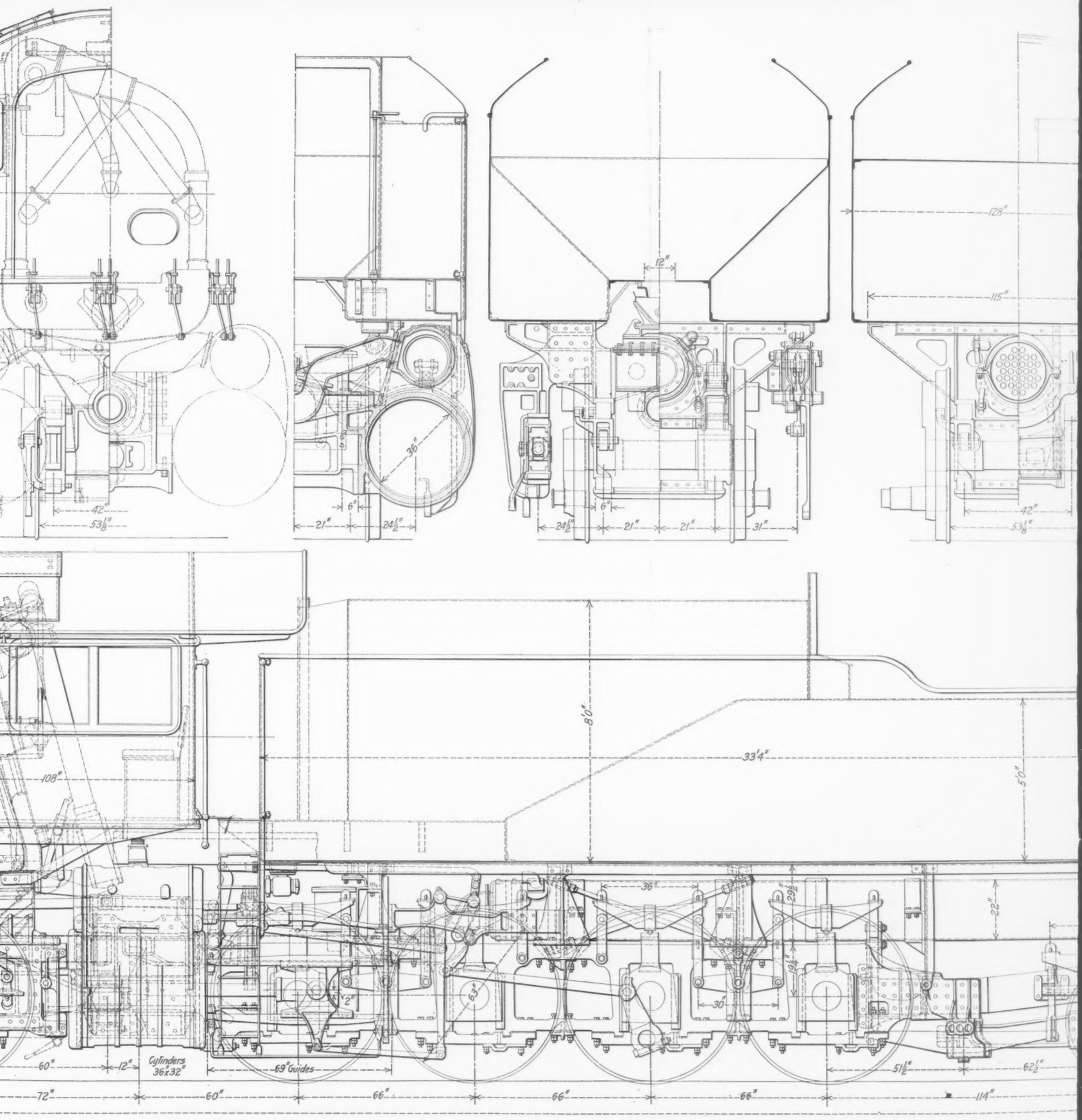
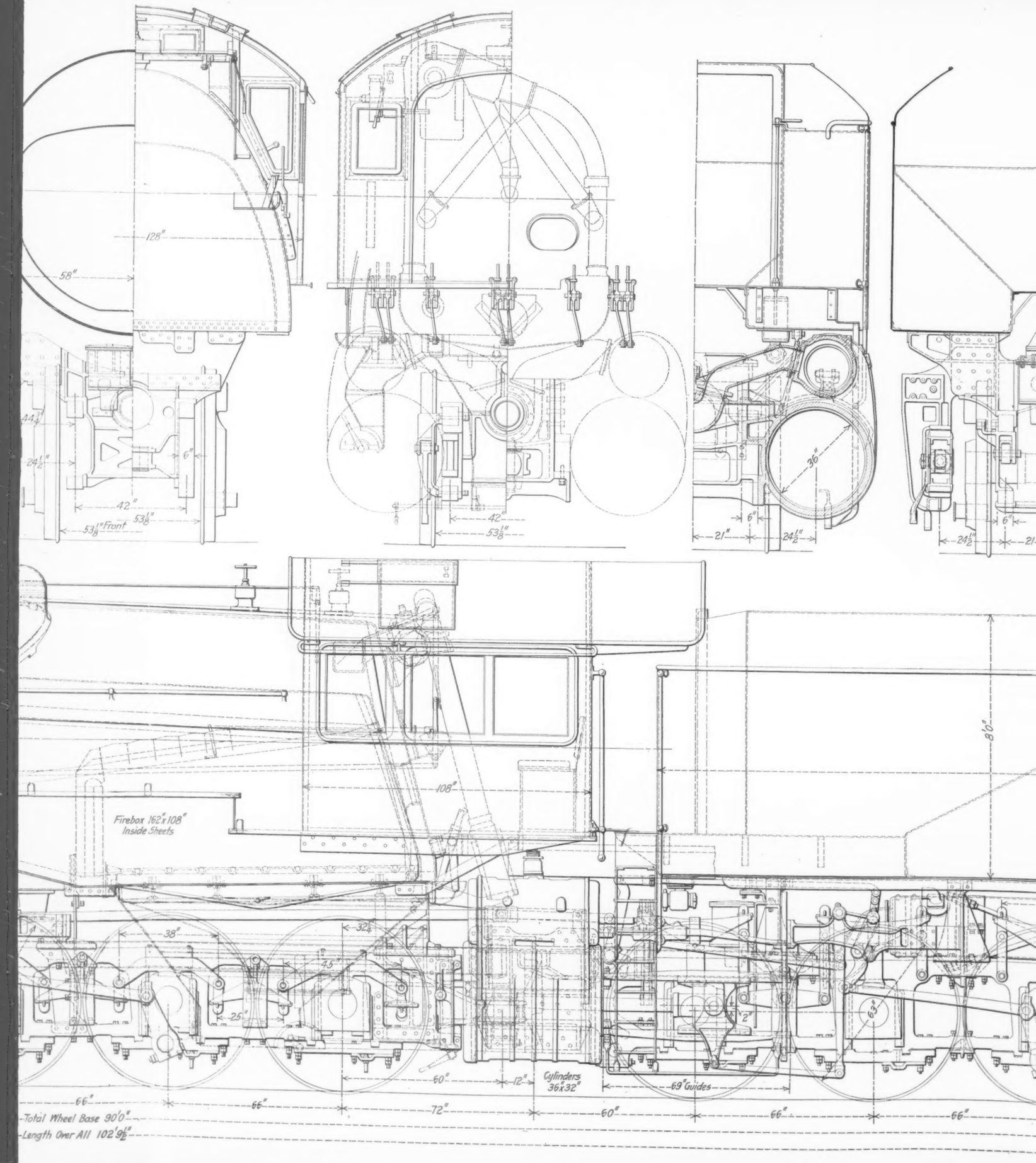
326, 2¼" Tubes 53, 5½" Flues
94"
102⅛"
36"
30"
38"
12"
Cylinders
36x32"
66"
66"
72"
60"



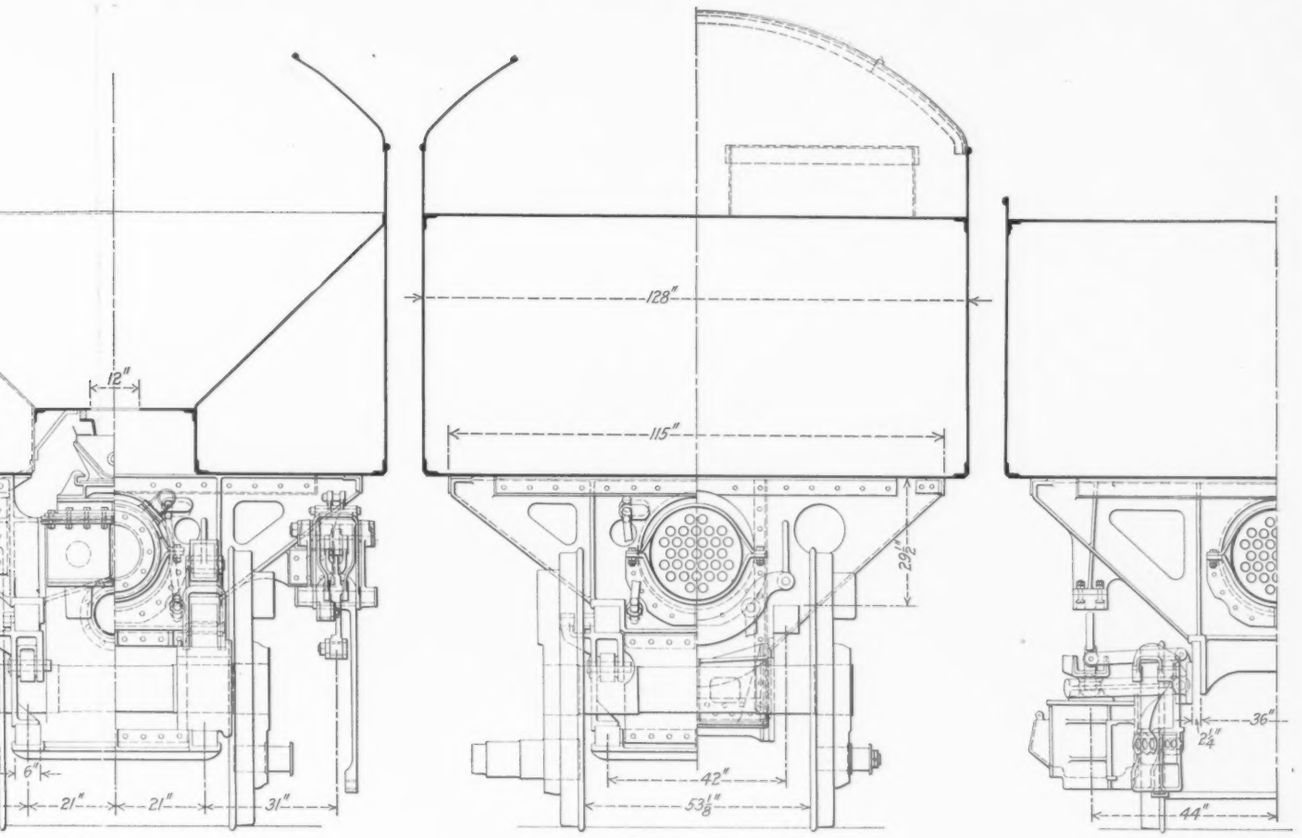
Triplex Compound Locomotive Built for the Erie Railroad by the Baldwin Locomotive Works; Total Weight, 853,000 lb.; Theoretical Tr



tical Tractive Effort, 160,000 lb.



e Baldwin Locomotive Works; Total Weight, 853,000 lb.; Theoretical Tractive Effort, 160,000 lb.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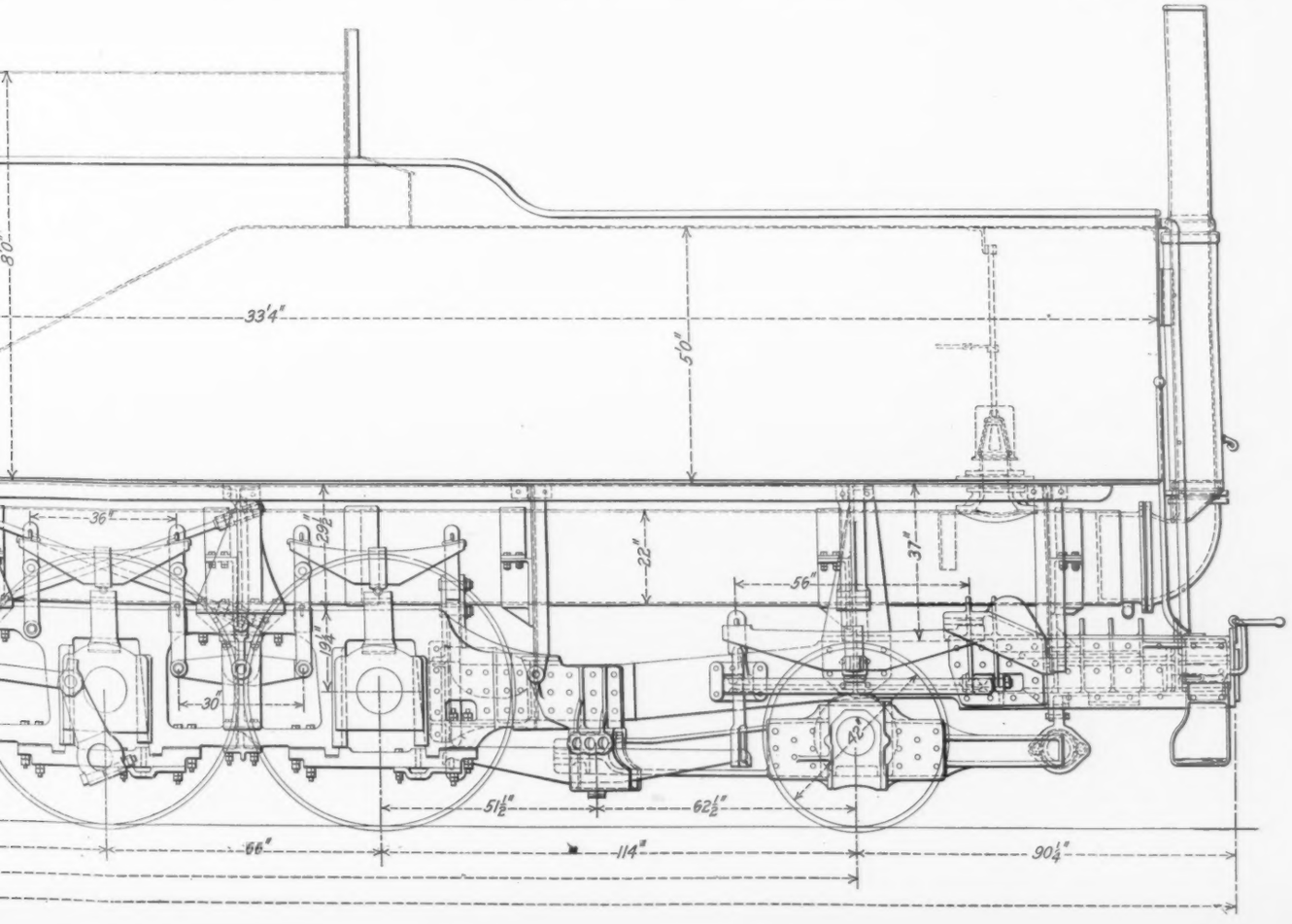
44"


80"
33'4"
50"
36"
29½"
19¼"
30"
22"
37"
56"
42"
51½"
62½"
66"
114"
90¼"

boiler feeding. A study of the locomotive ratios might lead one to believe that the locomotive is over-cylindered in respect to heating surface. This, however, should not be the case, because it is intended to supply feed water to the boiler at a temperature not below 200 deg. Fahrenheit.

The feed water heater is a long drum, running longitudinally under the center of the tank. It is 20 in. inside diameter, and contains 31 2¼ in. tubes, each about 24 ft. long. This drum forms a part of the rear low pressure exhaust passage, and is arranged so that the exhaust steam passes through the tubes, giving up some of its heat to the water which surrounds them. The water enters the drum through a special valve at the back end, and leaves at the front end, from which it is fed to the hot water pumps.

The hot water pumps are single acting, and each has one seven inch plunger. The pumps are two in number, one on each side, bolted to the high pressure guide yoke and driven by the crossheads by means of a simple lever, which gives the plungers a stroke of ten inches. The supply of water to these pumps is regulated by a valve in the cab.

The locomotive has two Hancock, type LNL injectors, each of 7,500 gal. per hour capacity. They draw cold feed water from the front end of the tank, and are to be used when the locomotive is not in motion, or if for any reason the hot water pumps are unable to supply sufficient quantities of water to the boiler.

RUNNING GEAR; ASH PAN

The pistons, all of which are alike, have cast steel dished bodies, surrounded by a cast iron bearing ring. Each of these rings has three packing ring grooves, and is secured to the piston by a retaining ring, electrically welded in place. The packing rings, both for the cylinders and valve chambers, are of Hunt Spiller metal.

The driving wheels and rods, valve gear and a number of other details are, as far as it was possible to make them so, interchangeable among the three engines. Many of these parts are also interchangeable with those used on the heavy Mikado type locomotives now in operation on the Erie.

The placing of driving wheels under the firebox, together with the necessity of passing the receiver pipe for the rear low pressure cylinders between the frames, very greatly restricted the space available for ash pan hoppers. It was, therefore, necessary to apply an additional hopper to each side of the ash pan far enough from the driving wheels to clear the driving rods. Ample air space has been supplied, for, in addition to the enclosed side openings provided for in the Talmage ash pan, an opening 60 in. by 8 in. has been cut in the outside sheet of each of the side hoppers, and two openings 12 in. by 12 in. were cut in the front sheet of the main hopper.

LUBRICATION AND OTHER DETAILS

Two Chicago, bull's-eye type lubricators, each with four feeds, are provided for lubricating the valves and cylinders, the steam cylinders of the air pumps, and the stoker engine. The several feeds are distributed as follows: One to each high pressure valve chamber, one to each high pressure cylinder, one to each receiver pipe leading to the low pressure cylinders, one to the air pumps, and one to the stoker engine. In addition to the lubrication supplied to the low pressure cylinders by the exhaust steam from the high pressure cylinders, and by the oil fed into the receiver pipes, small auxiliary static oilers are applied to each low pressure valve chamber.

Flange lubrication is provided for four pairs of driving wheels as follows: First pair of front low pressure engine, first and fourth pairs of high pressure engine, and fourth pair of rear low pressure engine. In every case the feeds are applied behind the wheel. Two Chicago four-feed flange oilers are used for this purpose. All driving boxes are fitted with Elvin lubricators.

The two sand boxes previously mentioned are piped so as to convey the sand in front of the first and back of the fourth pairs of driving wheels of the high pressure engine. There is an auxiliary sand box in the front low pressure cylinder saddle, which supplies sand in front of the first pair of driving wheels of this engine. For the rear engine a sand box is built around the rear low pressure exhaust pipe at the back end of the tank, and supplies sand back of the rear driving wheels of the third engine. White double air sanders are used throughout.

The starting valve is manually operated, live steam being admitted to the four low pressure cylinders by way of the high pressure exhaust cavities, and thence to the receivers.

Miner friction draft gear, type A-42, has been applied both at the back and front ends of the locomotive. Okadee drain valves have been applied as follows: One in each cylinder exhaust cavity, one in each air pump steam pipe, one in each injector delivery pipe, and one in the blower pipe. Among the specialties which have not been mentioned in other connections are: Air pumps, two New York, No. 5-A; cylinder cocks, Hancock pneumatic; piston rod and valve stem packing, King type; flexible air connections between engine and tender, McLaughlin; headlight, Dressel; water gage, Klinger type; engine truck wheels, solid steel; safety valves, Consolidated.

The efficiency of a locomotive used in slow, heavy service, is largely proportional to the percentage of total weight available for adhesion. In this respect the Mallet Triplex excels all previous designs, having 89 per cent of the total weight of the engine and tender on the drivers. In large Mallets of the 2-8-8-2 type this ratio is not above 65 per cent. This gain is the result of using the weight of the tender for adhesion.

The general dimensions, weights and ratios are given in the following table:

General Data

Gage	4 ft. 8½ in.
Service	Pusher
Fuel	Bituminous coal
Tractive effort, compound	160,000 lb.
Weight on leading truck	32,050 lb.
Weight on first group of drivers	250,000 lb.
Weight on second group of drivers	254,300 lb.
Weight on third group of drivers	257,300 lb.
Weight on trailing truck	59,400 lb.
Total weight on drivers	761,600 lb.
Total weight of engine and tender in working order	853,050 lb.
Wheel base, driving, each group	16 ft. 6 in.
Wheel base, total driving	71 ft. 6 in.
Wheel base, total engine and tender	90 ft. 0 in.

Ratios

Weight on drivers ÷ tractive effort	4.76
Total weight ÷ tractive effort	5.33
Weight on drivers ÷ total weight of engine and tender	.89
Tractive effort × diameter of drivers ÷ total equivalent heating surface*	1,088.32
Total equivalent heating surface* ÷ grate area	102.91
Firebox heating surface ÷ total equivalent heating surface*, per cent.	4.12
Weight on drivers ÷ total equivalent heating surface*	82.23
Total weight ÷ total equivalent heating surface*	92.10
Volume of equivalent simple cylinders, cu. ft.	51.32
Total equivalent heating surface* ÷ volume of cylinders	180.48
Grate area ÷ volume of cylinders	1.75

Cylinders and Valves

Diameter and stroke—2 H. P. and 4 L. P.	36 in. by 32 in.
Kind of valves	Piston
Diameter of valves	16 in.
Type of valve gear	Baker

Wheels

Driving, diameter over tires	63 in.
Driving, thickness of tires	3½ in.
Driving journals, diameter and length	11 in. by 13 1/16 in.
Engine truck wheels, diameter	33½ in.
Engine truck journals	6 in. by 12 in.
Trailing truck wheels, diameter	42 in.
Trailing truck journals	9 in. by 14 in.

Boiler

Style	Conical
Working pressure	210 lb.
Outside diameter of first ring	94 in.
Firebox, length and width	162 in. by 108 in.
Firebox plates, thickness	3/8 in. and 5/8 in.
Firebox water space	F., 6 in.; S., 5 in.; B., 5 in.
Tubes, number and outside diameter	326—2¼ in.
Flues, number and outside diameter	53—5½ in.
Tubes and flues, length	24 ft.
Heating surface, tubes	6,418 sq. ft.
Heating surface, arch tubes	88 sq. ft.
Heating surface, firebox and combustion chamber	380 sq. ft.
Heating surface, total	6,886 sq. ft.
Heating surface, superheater	1,584 sq. ft.
Heating surface, total equivalent*	9,262 sq. ft.
Grate area	90 sq. ft.

Tender

Water capacity	10,000 gal.
Coal capacity	16 tons

*Total equivalent heating surface = evaporative heating surface + 1.5 times superheating surface.

TESTS OF SUPERHEATER PERFORMANCE*

BY C. D. YOUNG
Engineer of Tests, Pennsylvania Railroad, Altoona, Pa.

The superheater used in the tests recently made on the Pennsylvania testing plant at Altoona was a Schmidt superheater of the fire tube type, or an altered form of it. The normal, or what is called in this paper the standard superheater, consists of tubes arranged in groups or elements and located in large flues in the boiler. There were 32 elements in the locomotive used in the tests.

Each superheater element is made up of four seamless steel tubes having an outside diameter of 1 7/16 in. and a thickness of 0.148 in., all connected by cast steel return bends to form a continuous tube or loop. The steam from the boiler enters the header in the smokebox, then flows into one of each of the 32 superheater elements, passing twice through the hot gases which surround the elements; that is to say, the steam flows to the firebox end of the boiler and then returns to the smokebox end and again flows back to the firebox end and

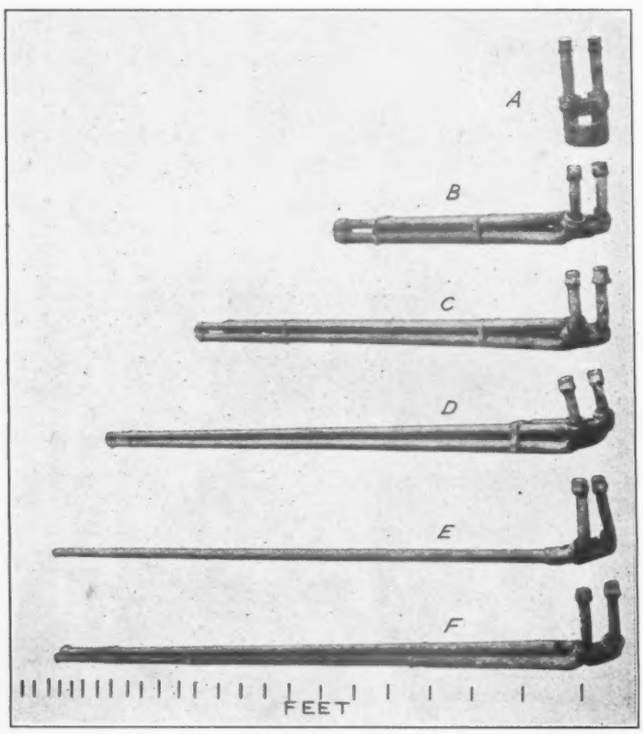


Fig. 1—Superheater Elements

Special or altered forms; *A*, short returns at header; *B*, ¼ length, 4 ft. long; *C*, ½ length, 9 ft. long; *D*, ¾ length, 14 ft. long; *E*, single pass, 19 ft. long; *F*, single pass dummy returns, 19 ft. long.

finally to the superheater header, entering a part of the header partitioned off to receive superheated steam. The steam then passes directly to the cylinders. This and similar arrangements are called in this paper "two-pass" superheaters. The superheater elements are connected to the header by a ball-joint connection, the ends of each element being drawn up to the header and held in place by a single bolt.

In order to obtain different degrees of superheat without in any way changing the water-heating surface of the boiler or the engine conditions, different forms of superheater elements were used, maintaining the same superheater header and large flues. The details of the arrangements are indicated in Figs. 1 and 2. One element of the standard superheater is shown at *H* in Fig. 2.

*From a paper read before the Franklin Institute, Philadelphia, April 30, 1914.

In Fig. 1, *A* is simply an element at the header of which it might be said that when all of the elements are in place they form a smokebox superheater; *B* is a quarter-length superheater. The superheater *C* is one-half length and *D* three-

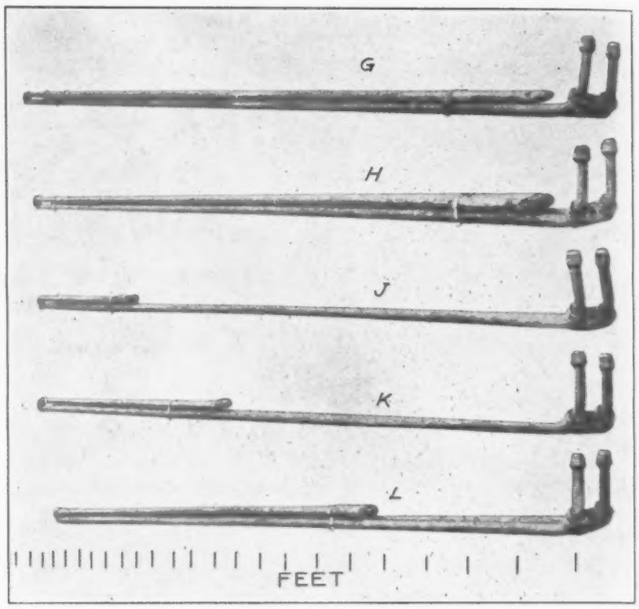


Fig. 2—Superheater Elements

The standard and special or altered forms; *G*, extra length, 20 ft. 5 in. long; *H*, standard, 19 ft. long; *J*, ¼ return, 19 ft. long; *K*, ½ return, 19 ft. long; *L*, ¾ return, 19 ft. long.

quarter length; *E* and *F* are of the same length as the standard, but of one pass; *F*, however, has additional pipes representing the second pass, but having no steam flowing through

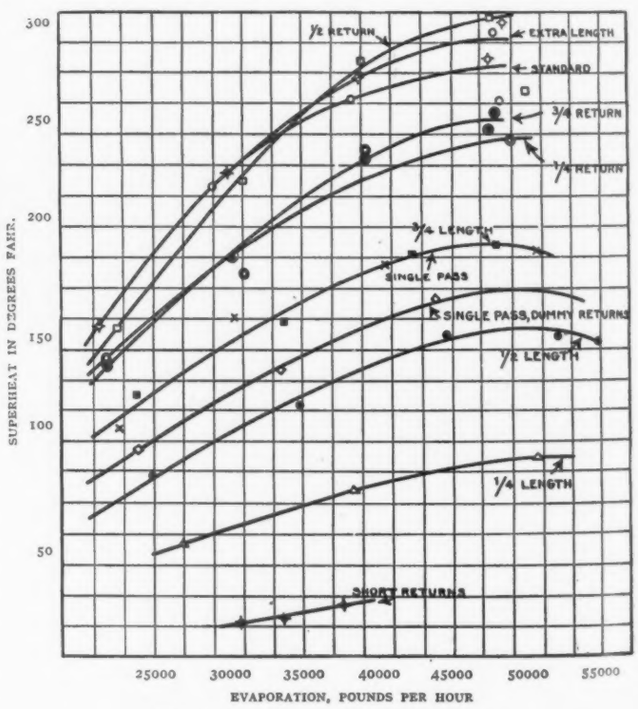


Fig. 3—Superheat and Evaporation

The superheat increases with an increase in evaporation up to 50,000 lb. per hour. Above this evaporation there appears to be a falling off in superheat, probably due to the heavy fire that must be carried, and the fact that all of the coal fired is not being burned.

them. These dummy pipes were used with this single-pass superheater to make the gas passage around the elements the same as with the standard arrangement. In Fig. 2, *G* is ar-

ranged in the same way as the standard, except that it is 17 in. longer for both passes, whereas *J*, *K* and *L* are similar to the standard arrangement *H*, excepting the return portion which has a length one-quarter, one-half, and three-quarters

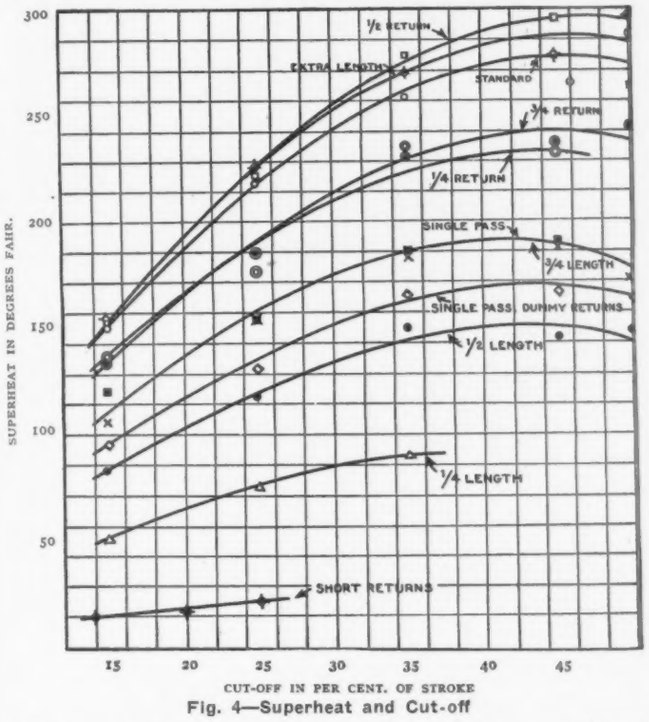


Fig. 4—Superheat and Cut-off

The superheat increases with the cut-off up to 45 per cent; beyond 45 per cent there is a falling off in superheat.

that of the corresponding part of the standard superheater.

In addition to the foregoing, the superheater of the three-quarter length arrangement of double-pass superheater had twisted plates inserted in the tubes of the superheater elements,

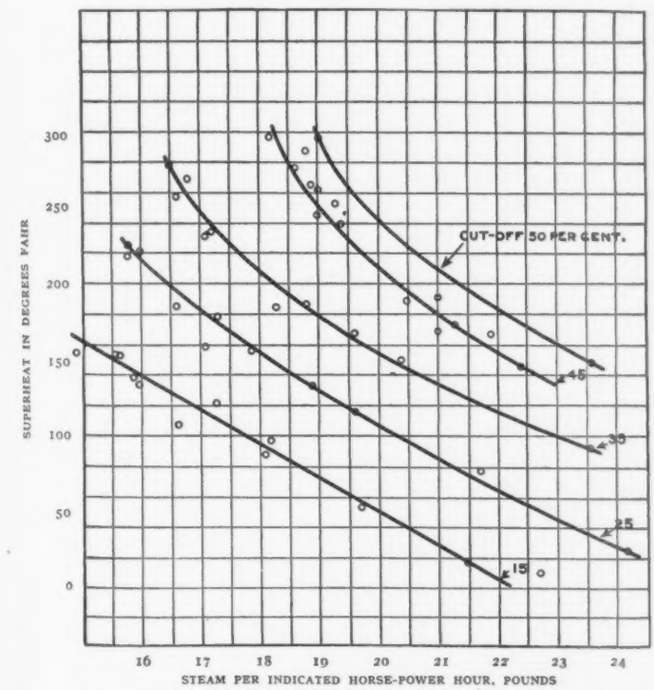


Fig. 5—Cut-off and Steam per Indicated Horse Power

the object being to cause a whirling motion of the steam so that its heat-absorbing action might be improved.

One locomotive was used for all of the superheater tests; it was a class K2sa Pacific type passenger locomotive of the Pennsylvania Railroad with a brick arch in the firebox. A complete efficiency test of this locomotive, when equipped with the standard form of the Schmidt superheater, was made before the special superheater tests were undertaken and the results are given in full in bulletin No. 18, "Tests of a Class K2sa Locomotive,"† where a further description and drawings of the locomotive are shown.

METHOD OF CONDUCTING TESTS

With each of the superheater arrangements, where it was possible, six tests were run, each having a length of one hour and a half, the cut-offs being 15, 25, 35, 45 and 50 per cent, except where the longer cut-offs could not be maintained. With some of the superheaters one test was made at a speed of 120 r. p. m., or 28 m. p. h., while all of the other tests were made at a speed of 240 r. p. m., or 57 m. p. h. Thus the variable of speed of the locomotive was largely eliminated, and it may be generally assumed that the tests were all made at 57 m. p. h. The steam temperature was measured by means of a mercury thermometer inserted in a well in the steam passage of the cylinder saddle, at a point where the steam is entering the steam

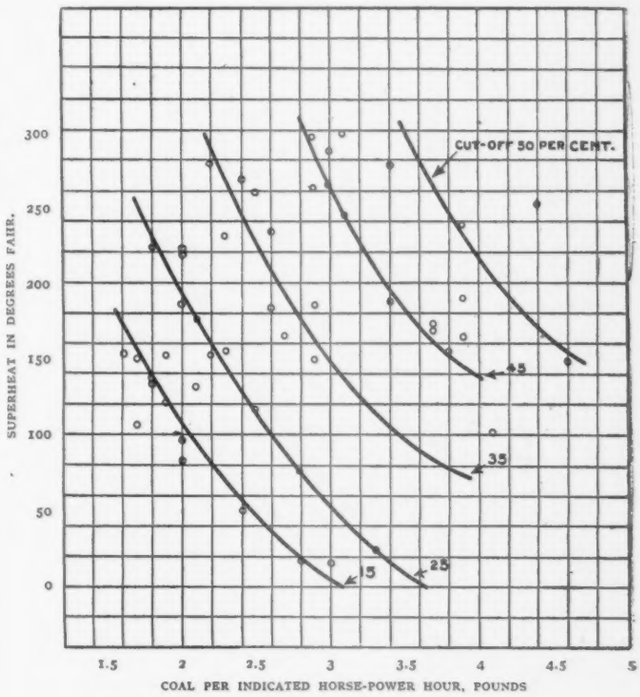


Fig. 6—Superheat and Coal per Horse Power

chest. The steam pressure was observed at this point and at the dome of the boiler by means of steam gages.

During the course of the tests the superheater elements were very carefully blown out with air at the end of each day.

While the tests were of one hour and a half in length, they have been recorded in the tables to appear as two tests, one of an hour duration and one of an hour and a half. It will be noted that the average for the latter part of the test or the last 60 minutes was, in most cases, slightly higher than for the longer time, for the steam temperature and superheat tend to rise slowly for perhaps three-quarters of an hour after the start of the locomotive (see graphical logs of tests, Figs. 12 and 13, for illustration of this effect). This effect may be due to the condition of the fire. The firebox temperature appears to increase during the whole time of a test run. At any rate the results for the latter part of the total time have been used in plotting all of the diagrams.

With the complete superheaters, such as the standard, the half-return, etc., the superheat, a few minutes after starting,

†Copies of this bulletin may be had upon application to the general superintendent of motive power, Pennsylvania Railroad, Altoona, Pa.

is high. At the beginning of one test the superheat was 228 deg., and it increased only 26 deg. during the one and one-half hours of running. In another test, with the half-return superheater, the superheat at starting was 240 deg., increasing 38 deg. to 278 deg. at the end of 90 minutes of running.

To obtain a range of superheat, superheaters of the full-length, three-quarter, one-half, one-quarter length and the short returns at the header were used. It was not expected that the shortened superheaters would develop an arrangement suitable or desirable for use in regular service; the only purpose in using them was to obtain wide variations in superheat.

RESULTS OF TESTS

The Effect of Different Degrees of Superheat.—The evaporation and superheat for all of the superheater arrangements are shown in Fig. 3, and an evaporation between 21,000 and 55,000 lb. per hour was obtained, the superheater consisting of short returns at the header, and having a heating surface of about 50 sq. ft. as compared with the standard, which has a heating surface of nearly 1,000 sq. ft., evaporates about 31,000 lb. of water per hour, and has an indicated horse power of 1,425,

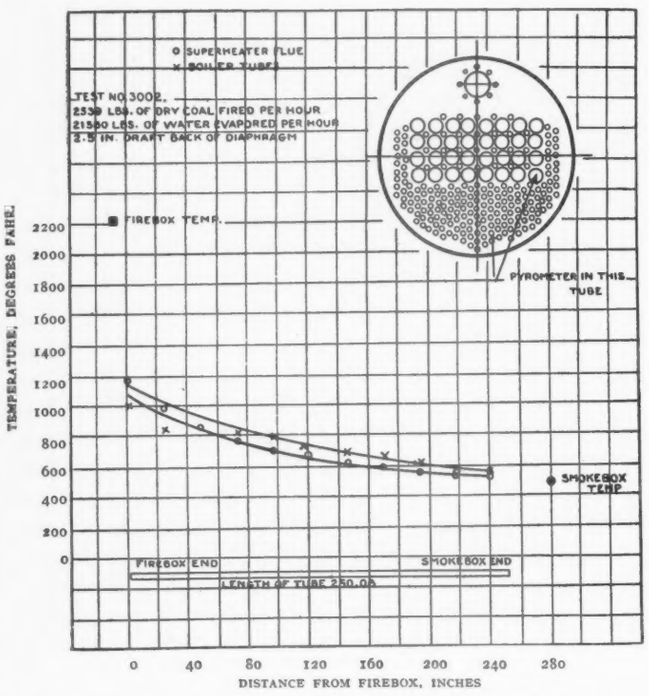


Fig. 7—Temperatures in the Superheater Flue and Boiler Tube

where, with the same cut-off and one of the extra-length superheaters, the evaporation is only about 21,000 lb. for this indicated horse power. This effect is caused by the small superheat obtained with the short returns, requiring a greater weight of steam for the power produced. We find further that this small superheater will not evaporate more than 37,600 lb. per hour or but 70 per cent of what the half-length superheater is capable. The small capacity of this header superheater is brought about by the fact that it does not extend into the large flues in the boiler. With these large flues open or unobstructed by the superheater elements, the boiler does not steam properly, the draft action is unchecked, and holes are made in the fire by the violent agitation of the draft. With the standard steam boiler, having all of the tubes of a small size or with the superheater boiler having the superheater elements in the large flues, the draft pulsations are smoothed out and the fire is not so violently agitated. The small superheater gives a maximum superheat of but 26 deg.

The superheaters of one-quarter, one-half, and three-quarter length show a regular increase in superheat produced, with the increase in length of superheater. The one-quarter length produces a maximum superheat of 90 deg., and the three-quarter length a maximum of 190 deg. It is also shown by Fig. 3 that as the superheat is increased, the evaporation, when running

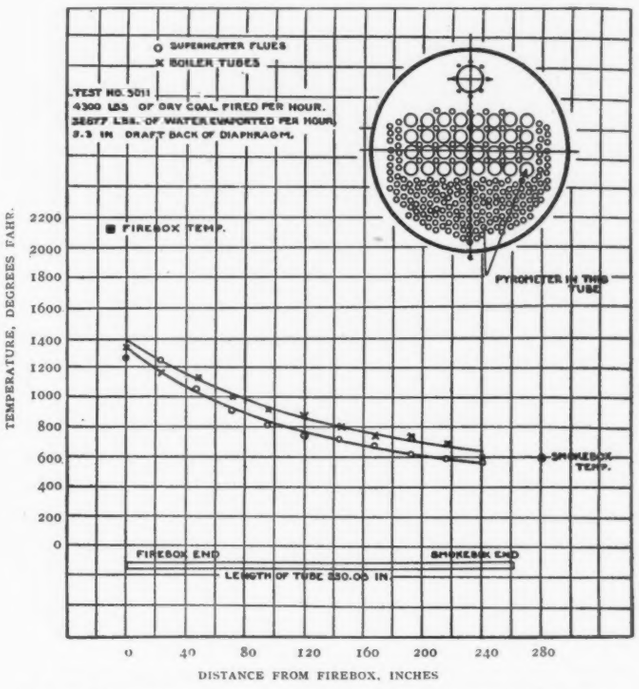


Fig. 8—Temperatures in the Superheater Flue and Boiler Tube

at a short cut-off, is decreased, and further, that the one-half length superheater gives the greatest evaporation that was obtained with any of the superheaters, about 55,000 lb. per hour. There would seem to be a best superheater length or area for

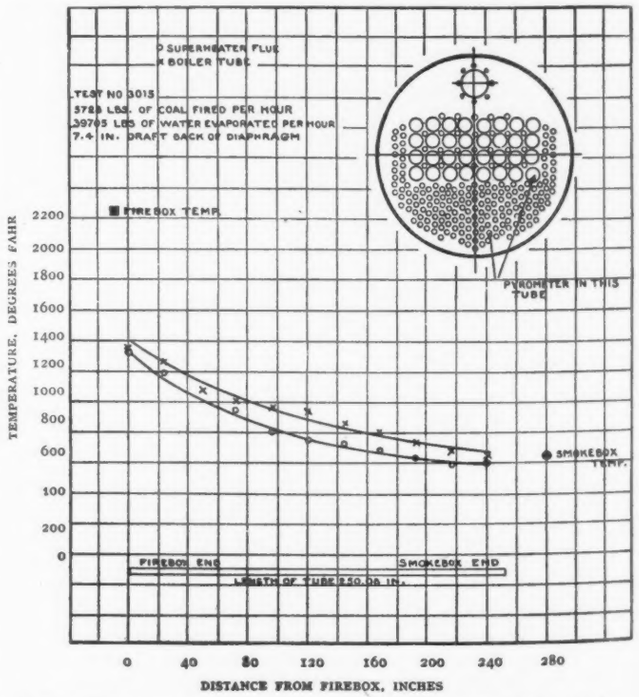


Fig. 9—Temperatures in the Superheater Flue and Boiler Tube

maximum evaporation, but it must not be understood that this superheater, which is best for evaporation, gives the maximum horse power.

The extra length shows a higher superheat than the standard

length, but there might be difficulties in the use of this long superheater where the ends come within a few inches of the firebox end of the flue, and the one-half return gives fully as much superheat; there would seem to be no advantage in the extra length, with the disadvantage of increased friction due to the longer steam passage.

Referring now to Fig. 4, which shows superheat and cut-off, we find that the superheaters arrange themselves in very nearly the same way as in Fig. 3, and this is to be expected because, on account of the constant speed, the evaporation is dependent almost entirely on the length of cut-off.

Considering now the economy resulting from the superheat we have in Fig. 5 the cut-off and steam per indicated horse power. This diagram expresses graphically the essential facts

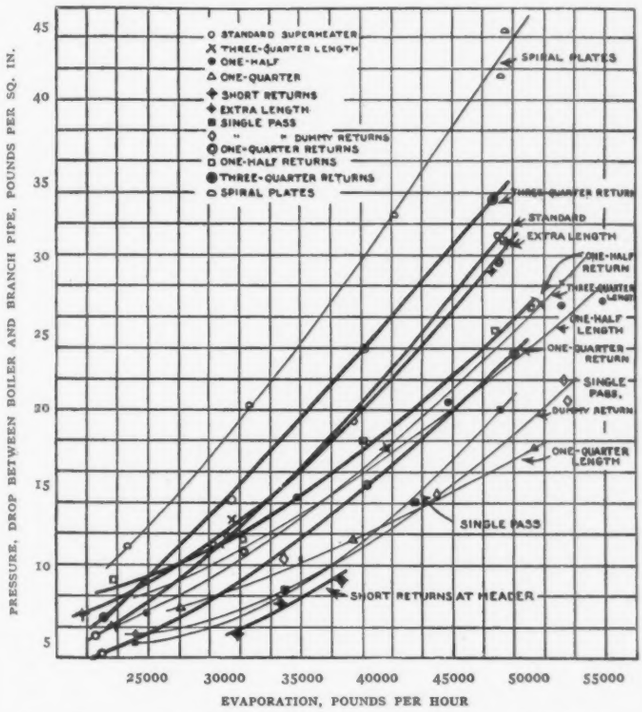


Fig. 10—Loss in Steam Pressure Between Boiler and Cylinders

The superheater with spiral plates in the tubes shows the greatest loss in pressure, while the short superheater consisting of short returns at the header shows the least loss.

for which the experiments were made, and gives for the first time authentic data upon the economy due to superheat unobscured by other variables.

The points of this diagram do not indicate the arrangement of the superheater, but show the effect of both the superheat and cut-off on the economy in steam. We find from the diagram, which shows a superheat ranging from zero, or practically saturated steam, up to 300 deg., that for every increase in superheat, at every cut-off, there is a saving in steam, and that at 15 per cent cut-off, at the speed of these tests, for every 20 deg. rise in superheat there is a reduction in water rate of one pound per indicated horse power hour. At 50 per cent cut-off this increases to a requirement of about 40 deg. rise for the same reduction in water rate.

With a cut-off of 15 per cent and a superheat of about 70 deg., we can obtain a water rate of 19 lb. per indicated horse power per hour, while if the cut-off is extended to 50 per cent at the same speed, the superheat must be increased to 300 deg., so that the water rate will remain at 19 lb. The very great importance of the length of cut-off is thus apparent, but even with the longest cut-off that is shown the water rate does not reach 24 lb., or what may be called the minimum water rate for saturated steam. It thus appears that superheat always shows a saving in steam if the cut-off does not exceed 50 per cent. Similar conclusions may be drawn from Fig. 6, which shows the superheat, the cut-off and coal per horse power hour.

Some time before these superheater tests were undertaken a series of efficiency tests with the standard superheater was made with this locomotive, and Figs. 7 to 9 show the temperature measurements in boiler tube and superheater flue made at that time. In Fig. 7 the temperature in the superheater flue is 1,160 deg. at the firebox end, falling to about 540 deg. at the smokebox end. The steam temperature for this test is 572 deg. It will thus be seen that at about 170 in. from the firebox the steam temperature equals the temperature of the gases, and there would be no gain by extending the superheater return any distance forward of this point. This return portion extends forward to a point 148 in. from the firebox. Figs. 8 and 9 show very similar results in regard to the point where the steam temperature becomes as high as gas temperature. From a consideration of these temperature curves, one reason for the good results from the half-return superheater is made clear.

There is a loss in steam pressure as the steam flows from the boiler through the superheater to the steam chest, and this loss in pressure is shown graphically in Fig. 10. All of the superheaters are shown on this diagram. As would be expected, the superheater having the spiral plates in the tubes shows the largest loss in steam pressure as the steam flows through the superheater. These plates have a retarding effect, and, as shown in other diagrams, the increase in superheat obtained by their use does not overcome the loss in power due to the pressure drop. The short returns show the least drop in pressure, as is to be expected, the passage through the super-

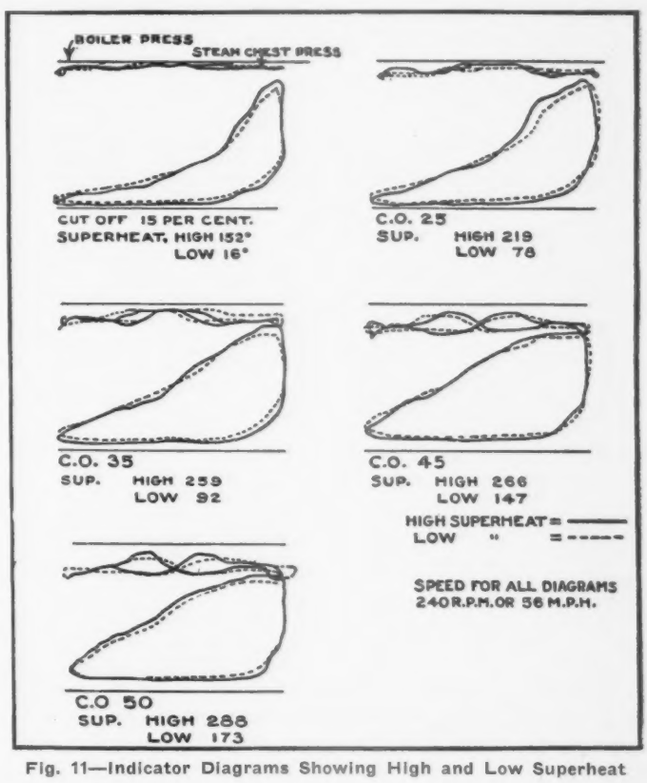


Fig. 11—Indicator Diagrams Showing High and Low Superheat

heater in this case being 25 in. in length. The single-pass superheater shows a little greater drop in pressure, it having a length of 497 in.

Indicator diagrams for high and low superheat are shown in Fig. 11. The first of these diagrams is for a cut-off of 15 per cent. In one case the superheat is 152 deg., and in the other 16 deg., or a difference of 136 deg. There is a drop in pressure between the boiler and steam chest of about 8 lb. The dotted lines are for steam with a low superheat and the full lines for steam with high superheat. During the admission to the cylin-

der the steam having a low superheat shows the lowest pressure during the whole period of admission. During expansion, however, the pressure for the steam of low superheat is higher than for the highly superheated steam. During the return stroke of the piston, while the steam is flowing out of the cylinder, the steam having a low superheat shows a higher back pressure than the highly superheated steam. The same characteristics are evident on all of the diagrams, and the indications are that the highly superheated steam is more fluid or flows more freely into and out of the cylinder than does the steam of low superheat. It was not possible to make a direct comparison of highly superheated and saturated steam, but there are large differences in the superheat in each pair of diagrams.

The results of the tests show conclusively that there is an almost direct relationship between the economy in water and fuel and the degree of superheat, within the range of the experiments. It would be interesting to know how far this general law holds true for a given economical working cut-off. It is seen that if the superheat, at a short cut-off, could be obtained as high as that which was obtained for a long cut-off economies more remarkable than are shown, in steam per indicated horse power hour, would no doubt have been possible. The desirability, therefore, of high-degree superheating for locomotive practice cannot be questioned. Other deductions may be drawn from these tests which, summarized, may be expressed as follows:

(*a*) The standard superheater now in general use is found

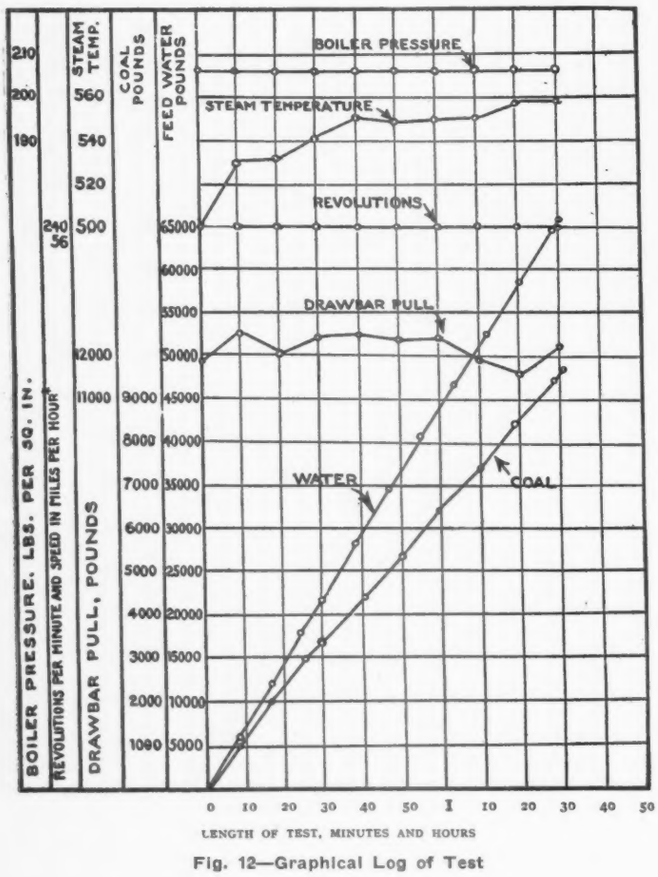


Fig. 12—Graphical Log of Test

to give very satisfactory results with a possibility that some of the return portion could be eliminated with no detriment to the superheat obtained, and with an advantage in cost of material.

(*b*) Too much importance cannot be attached to the length of superheater; it must extend as far toward the fire as practicable limitations will allow, considering the life of the elements in the hot gases.

(*c*) There is an advantage in the return portion of the superheater, but this part may be shortened, to what extent has not yet been finally determined.

(*d*) As the superheat is reduced, the evaporation of the boiler is increased within certain limits; in other words a boiler without superheater shows a larger maximum evaporation than one with a superheater. The power of the locomotive, however, does not increase with the greater weight of steam produced; on the contrary, the power is reduced with the reduction in superheat.

(*e*) Within the limitations of these tests, the highest superheat does not result in the lowest water rate; this is on account of the fact that to obtain the highest superheat the locomotive may be run at an excessively long cut-off, the long cut-off increasing the water rate to a greater extent than is compensated for by the increase in superheat.

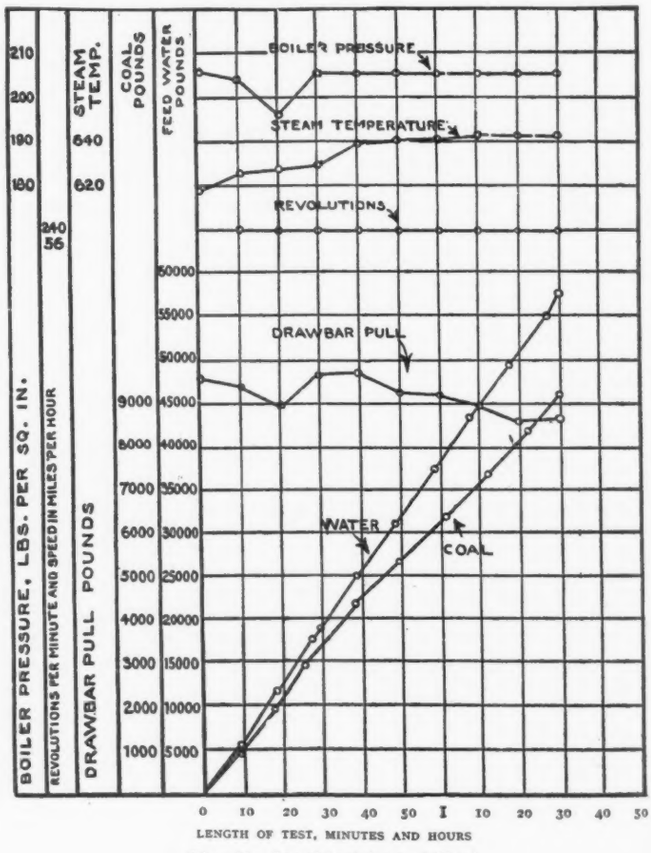


Fig. 13—Graphical Log of Test

Applying now the knowledge obtained from these tests to locomotive practice, it is seen that the advantage of superheating may be utilized in two ways; either in coal and water saved, due to a reduced water rate, or by burning the same amount of coal as would be required in the boiler where it is generating saturated steam and obtaining a decided increase in the power output of the locomotive. If we exclude conditions of starting, this would permit superheater locomotives to haul heavier trains with a saving in transportation facilities and labor.

Another advantage in superheating which only recently is being given consideration, is that, by the application of superheaters small locomotives may be made to haul trains equal to those now hauled by saturated steam locomotives of greater weight, and this means that where traffic has outgrown the locomotive and the right of way conditions not permitting of heavier units of power being introduced, trains may be increased in weight by the adoption of superheaters.

CAR DEPARTMENT

WHAT SHOULD BE DONE WITH WOODEN UNDERFRAME CARS?*

BY CHARLES E. WOOD
Foreman Freight Car Repairs, Union Pacific, Kansas City, Kan.

The recent changes in Rule 120, of the M. C. B. Interchange Rules and the extraordinary conditions which made the change necessary, brought to the attention of car department officers and employees very forcibly the question, "What is to be done with our wooden underframe cars?"

Some roads that seem loath to part with these relics of a pioneer day are, to use a familiar expression, "throwing good money after bad" in attempting to modernize them by equipping them with new appliances, forgetting the old axiom that the strength of a chain is in its weakest link and that in spite of new and improved draft gear or metal roof, the car is still old. The sills, although apparently sound, are dead and brittle, and will not stand the shock which they are subjected to with the heavy locomotives and switching methods now in use.

The writer recently noticed a 34-ft., 30-ton car, bearing the initials of a large eastern line, which was about 20 years old and still had the original wooden body bolsters and short draft timbers. This car had been recently overhauled and equipped with a friction draft gear of the heaviest type, and a new outside metal roof, as well as other repairs representing an outlay of at least $100. But the car was not fit to go in the head end of a heavy train. There is no doubt that the draft gear was guaranteed to withstand about double the shock that the wooden sills would stand, and the folly of applying this heavy gear to short wooden timbers depending on four or five bolts is self-evident.

Another method is to put "Rough Freight Only" signs on the car and let it run until some unfortunate engineer stops his train too suddenly and breaks it in two. There are several good reasons why this plan is a failure, aside from the above possibility, the main one being that switchmen are a class of men that do not believe in signs. Furnish a switchman with two cars, one boarded as above and the other a new first class steel underframe car, and order him to set one to load scrap iron and the other at the house for merchandise, and anyone knows where to look for the "Rough Freight Only" car. If you mildly suggest that he ought to have set them the other way, you will be told "A car is a car," which is a fact you cannot dispute.

Then we have all seen the car bearing the sign, "Set at rear of train," and it is astonishing how seldom it gets there unless it is after the draft rigging has pulled out. And who has not seen the sign "For Local Service Only," between two points you have never heard of, adorning the sides of a car many hundreds of miles from its home rails?

The only practical way to solve this problem is to set a limit of expenditure on this class of equipment and whether the car is at a home shop or some foreign line is asking for home route cards, when the estimate runs over that amount, dismantle it and be thankful that one more menace to safe train operation and another help toward the high cost of freight car repairs, is disposed of.

One danger where there is a limit of expenditure is that the estimate is based too often on such repairs as are immediately necessary, instead of subjecting the car to a rigid inspection and including all the repairs which would be required to put the car in first class condition. For example, a car may be in a shop and have a side sill renewed and two draft timbers applied, only to show up a month or so later at another repair point with the roof loose and shifted. The foreman there sees the repairs recently made, and decides that the car is worth a new roof. He can apply one and still come within the limit; but if the first man had used good judgment he would have reported fully the condition of the car and secured proper disposition. This is a matter which should be watched closely, as a great deal of money can be wasted in this way.

The wooden car must make way for its successor, the steel underframe car. The changes in the rules in the last few years show that the Master Car Builders, as a body, recognize this, and the quicker all roads eliminate them, the better it will be for everyone who has anything to do with them, whether shipper, trainman or carman.

*Entered in the Car Department competition which closed February 1, 1914.

CAR DEPARTMENT ORGANIZATION AND EFFICIENCY*

BY A. CAREY

At the present time when railroad transportation rates are stationary perforce, and the cost of all material pertaining to railroad operation and maintenance is greatly increased, special effort should be made toward improving shop efficiency. It is the purpose of this article to point out some of the losses, due to defective organization, mismanagement or inefficiency in some particular.

ORGANIZATION

The first and most essential step toward the highest possible shop efficiency, is intelligent organization of the shop forces. The principal feature of shop organization, and yet one that is perhaps too often lost sight of, is the equitable balancing of forces in the various interdependent departments, in order to prevent a blockade of work in one department which has not its proper quota of men, while the preceding department is oversupplied with help.

A condition such as this is perhaps oftener to be found under the day work plan, than under the piece work system. In fact, it is the piece work system that offers the best possible basis for balancing the forces, because all workmen more nearly exert their best efforts when performing piece work.

The various divisions or subdivisions of work in the different departments bear definite ratio in working units to each other, and unless this ratio is ascertained, and the forces of the various departments proportioned accordingly, there is no means of ascertaining whether the highest degree of efficiency has been attained. On the other hand, when the forces of the various departments are properly balanced, all lost motion will become at once apparent for the reason that in that case, each department would necessarily have to keep step with the others or else expose its own deficiency.

SYSTEM

A most important feature of shop organization is a good practical working system, not so elaborate as to be fettered with too much red tape, but sufficiently elastic to meet contingencies as they arise, and rigid enough to counteract all lost motion. The absence of some semblance of a working system is as fatal to success as a lack of discipline would be to an army. There is a distinct loss, though it may be small, connected with every operation of shop work unless particular care has been taken to ascertain and eliminate it. The smith who cuts off a piece

*Entered in the Car Department competition which closed February 1 1914.

of iron two inches too long, the machinist who uses a dull chisel, the carpenter who uses a dull saw, the painter who places his bucket in the wrong position, or continues to use a brush that has worn to a mere stub, the upholsterer whose thread is so long as to require two movements of the arm at each stitch to draw up the thread, all constitute small items of loss. In the aggregate, they amount to a distinct loss of not insignificant proportions. A thorough working system will expose and eliminate all such losses.

QUALIFICATIONS OF SHOP OFFICERS

Shop efficiency depends mainly upon intelligent shop organization, and competent workmanship wisely directed. No officer can wisely direct his subordinates, or intelligently give needed instructions as to the details of the work, unless he himself is fully competent and keeps informed in the advances being made elsewhere along mechanical lines.

Another qualification essential in a shop officer is the ability to draw out the latent resources of his workmen. It is more advisable in most instances to place a workman more or less on his own resources than to undertake to give detailed instructions covering every stage and every phase of the work. By this means a workman's sense of pride may be stimulated, the foreman is relieved of much detail work, the workman is improving his ability, and the result to all concerned is more satisfactory. As a further means to being a successful foreman, a man should not only be a competent mechanic, but he should also be a student of human nature, broad minded, have a mind of his own, be not easily swayed by religious, political or fraternal influences, but endeavor to deal justly with each employee according to his individual merits.

SUPERVISION

The organization of the supervising force in some instances seems to be a haphazard arrangement. One foreman is often required to handle from five to ten times as many men as another foreman. It should be apparent to any practical man that such conditions cannot work out satisfactorily.

A foreman who gives due attention to all the necessary details of his department can handle profitably only a limited number of men. No foreman can either properly conserve his own energies or do justice to his position, who undertakes to go beyond a reasonable limit in this particular. There is no rule for ascertaining the exact limit in such cases; one's own abilities, circumstances and conditions are the determining factors. A larger force, if concentrated, can be handled by one man than in cases where workmen are scattered over a large area. Some companies have found it advisable to increase the supervising force rather than the working force. Imperfect supervision represents one of the largest items of loss to be found in the shop, but can be largely prevented where a co-operative spirit is dominant in the supervising force.

Brute force is always a losing factor in handling men. The foreman who swears at and bullies his workmen, and the foreman who is too passive to administer needed reproof, are the two extremes in supervision, neither of which pays.

Too much supervision, or supervision of the meddling kind, does not make for efficiency; it is a reflection either on the foreman or his workmen. A famous manufacturer once said that he attributed his success to his ability to draw around him the kind of men who knew how to do the things he wanted done better than he could do them himself. It is not to be expected that a foreman will be able in every instance to excel his workmen in every piece of handicraft, but he should have a general knowledge of the work, and the ability to direct it by the shortest route to a successful conclusion.

ANTIQUATED MACHINERY

Of the various obstacles to shop efficiency, one of the worst is antiquated machinery which should long since have been replaced with modern machines, capable in many instances of more than quadrupling the output. The majority of railways have wisely installed modern machinery; but in some instances there is yet out-of-date equipment to be found.

CROWDED SHOPS

A costly mistake sometimes made in shop management is that of overcrowding, by endeavoring to perform all classes of car work in the same building. The various shop conditions required in such cases by the different classes of workmen in order to perform their work properly, cannot possibly be obtained at the same time. For instance, the carpenter in warm weather requires open doors and windows, a condition which cannot be considered in the work of the painter during the varnishing and finishing stages of his work. These conditions prevent the free movement of the workmen; ill feeling is sometimes started by encroachments upon each other's work; system and discipline are broken down, and the result is a decreased output of inferior quality.

A separate department for each class of work is essential to economy. One of the larger roads finds it economical to make five transfers of its coaches from shop to shop before reaching the final stage of repairs. While it is true that all shops have not the shop room necessary to handle work in this manner, much improvement along this line is possible in many cases. It is possible that this manner of handling work has obtained so long in some shops, that those responsible for it have deluded themselves into the belief that a change to more profitable methods is impossible, but it is a distinct loss, and a large one.

CLEANLINESS AND COMFORT OF WORKMEN

There is nothing that indirectly conduces more largely to shop accomplishment than clean surroundings and comfortable conditions for the workmen. There is nothing so disparaging nor so fatal to a workman's pride as being compelled to work in a dirty, uncomfortable shop. Clean and comfortable surroundings tend in no small measure to the making of careful and capable workmen, and vice versa.

SCHEDULING WORK

Some shops do not schedule their output, but this is a matter of importance, and helps in no small degree to increase the total output of the shop. To appoint a definite time for the departure of each car affords each interested workman something definite to work to, and enables him to judge in advance how well (or how slightingly) he can perform his part of the work in the time allotted. Scheduling work has about the same effect on workmen as scheduling the departure of a train has on the traveling public.

AMPLE AND SUITABLE WORKING MATERIAL

A shop equipped with the most modern machinery, and employing the most approved methods in handling work may even then be operated at a distinct loss unless provided with ample and suitable working material. Some railroad companies have deemed it advisable to operate the storehouse under a management separate from the shop, which was not formerly the custom; but the economy of this plan may be questioned, as the delays in procuring material seem in some instances to be greater than under the former method. There is, however, no apparent reason why this should be so; in fact the contrary should be the case. However, the storehouse is the right arm of the mechanical department, and must have its best support in order to obviate serious loss from that source.

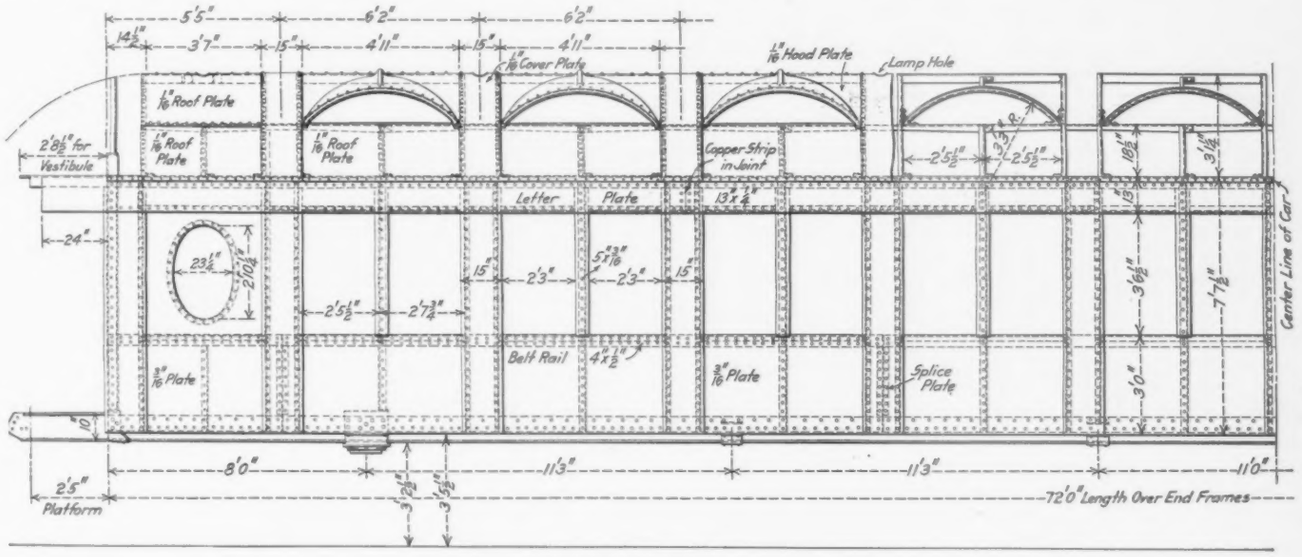
Australian Wheat Trade.—The Australian minister for lands and agriculture has announced that the government will lose no time in bringing into operation a comprehensive scheme for the bulk handling of wheat. In his outline of what he describes as "an up-to-date, effective, and comprehensive scheme," he says it will include a central elevator in Sydney, one at a northern port not specified, and a third at Jervis Bay.

CANADIAN PACIFIC STEEL COACH

A Car Which Is 72 Feet Long and Weighs 114,800 Pounds; Unusual Type of Roof Structure Employed

About two years ago the Canadian Pacific designed and built at the Angus shops, Montreal, an all-steel day coach. The car was placed in regular service and results with it have been so satisfactory that there are now under construction at Montreal 12 all-steel baggage and express cars, 25 all-steel first class coaches and 30 colonist cars. These cars will be of a similar construction to that shown in the illustrations. The first class coach, which is shown in the half-tone engraving, is 72 ft. long over the end sills and has a seating capacity for 84 passengers. The light weight on four-wheel trucks is 114,800 lb. The design of steel truck used was described on page 26 of the January, 1914, issue of the Railway Age Gazette, Mechanical Edition.

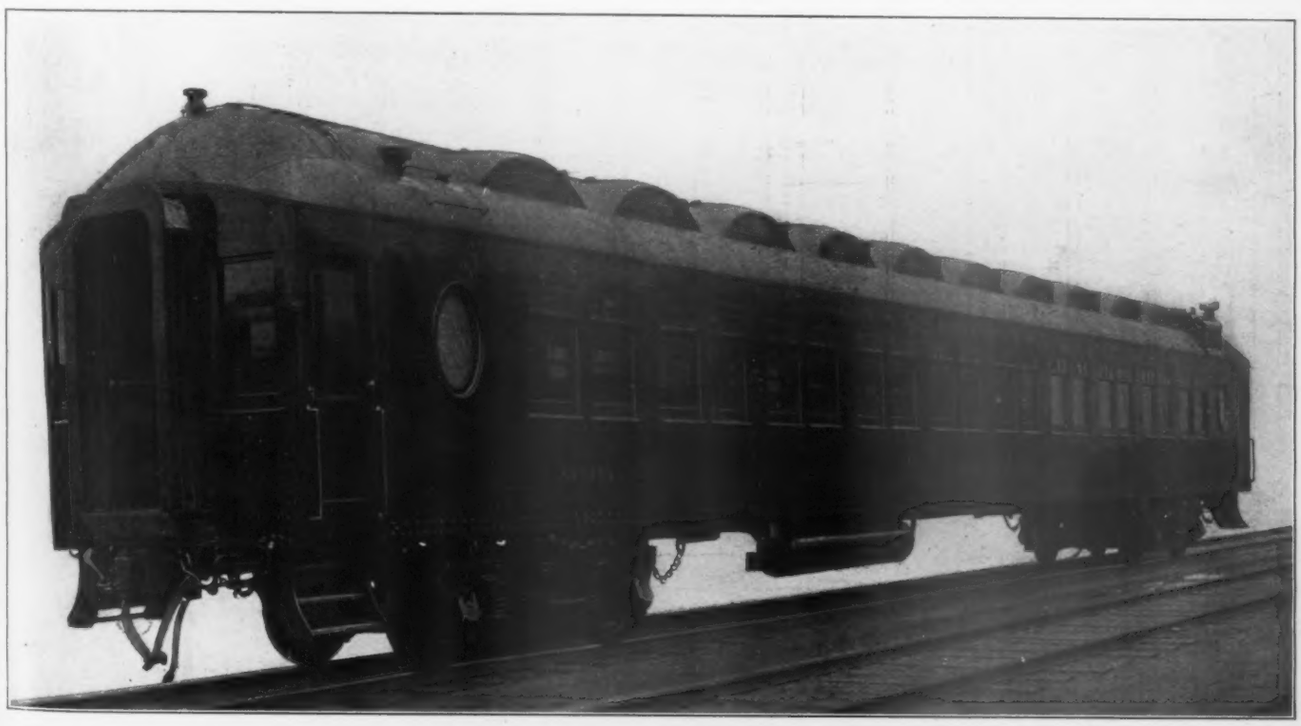
The distinctive features of the car are cork insulation veneered steel lining, individual truck brakes and a modified arch or turtle back roof that preserves the clerestory effect inside and renders possible the use of deck sash for light and ventilation.



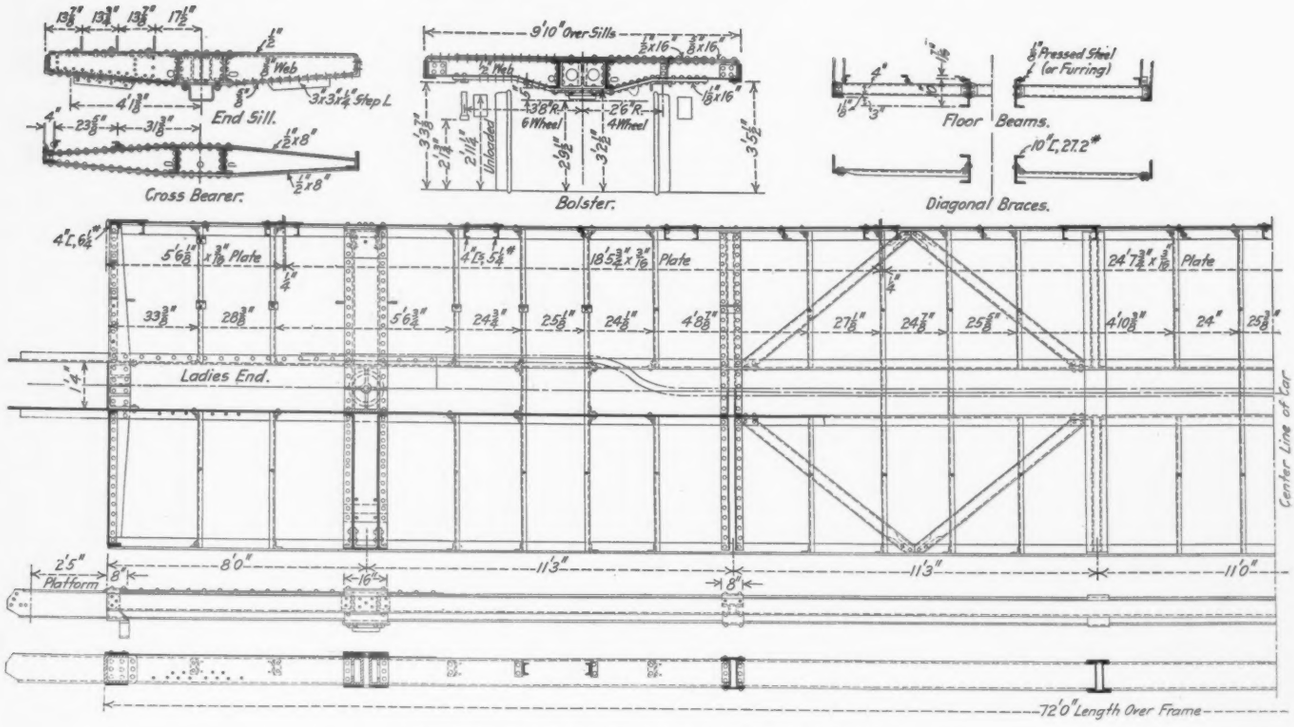
Arrangement of the Side Framing and Sheathing

UNDERFRAME

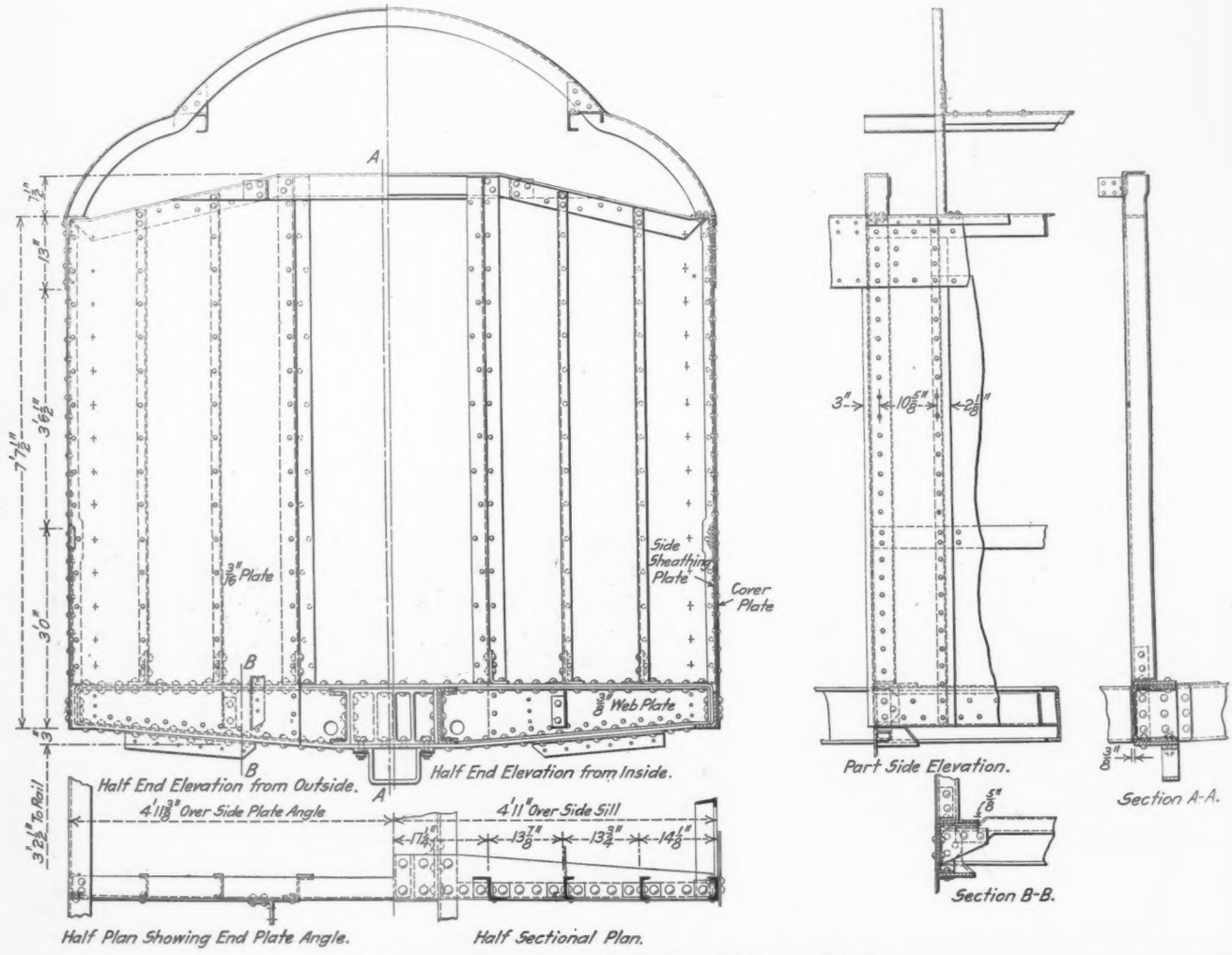
The center sills are 10 in., 27.2 lb. channels, spaced 16 in. back to back and extend through between the platform end sills. A



Steel Coach in Service on the Canadian Pacific



Underframe of the Canadian Pacific Steel Coach



End Construction of Steel Coach on the Canadian Pacific

5/16 in. top cover plate is used, extending from the end sill to a point 18 in. back of the body bolster, and a ¼ in. bottom cover plate extending between the body bolsters. The side sills are 6 in. by 4 in. by ½ in. angles, extending between end sills, and there are four cross bearers built up of 3/16 in. pressed webs and ½ in. by 8 in. cover plates.

The body bolsters are built up of ½ in. pressed web plates between the center and side sills with a casting between the center sills. A ⅝ in. by 16 in. top cover plate extends the entire width of the car and is turned down at the ends and riveted to the side sills. There is an additional ½ in. by 16 in. cover plate, 6 ft. 11½ in. long placed on top of this, the rivets extending through the two cover plates and the flanges of the webs. A 1⅛ in. by 16 in. plate extends 4 ft. ¼ in. on either side of the center of the car and is riveted to the center sills and the bottom flanges of the bolster web. The center plate is riveted to this plate.

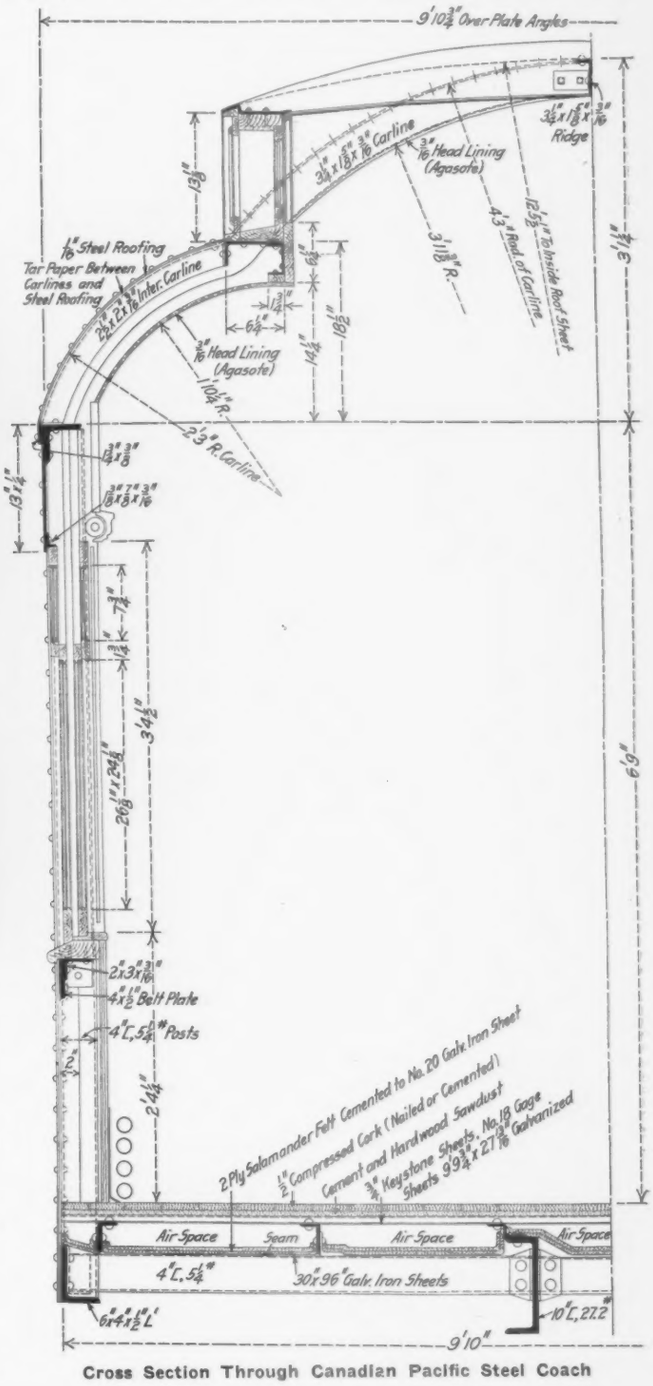
Interior of Canadian Pacific Steel Day Coach

There are eight diagonal braces consisting of 4 in., 5¼ lb. channels extending from the center to the side sills. Four of these are placed in the form of a diamond between each of the two pairs of cross bearers.

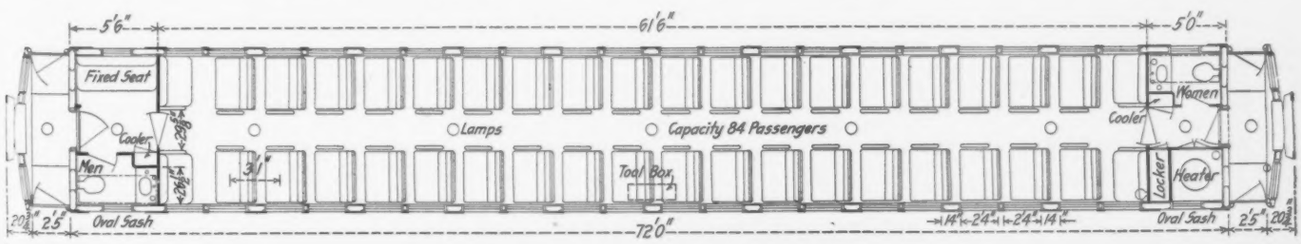
The end sill is composed of ⅜ in. fillers with a casting between the center sills. A ½ in. top cover plate extends across the car and is bent down and riveted to the side sills in a manner similar to that used in the bolster. There is also a ⅝ in. bottom cover plate.

SIDE AND END CONSTRUCTION

The belt rail is a 4 in. by ½ in. continuous plate and is reinforced between the side posts by 3 in. by 2 in. by 3/16 in. angles. The side posts are 4 in., 5¼ lb. channels, and the corner posts 4 in., 6¼ lb. channels, while the side plate is a 4 in. by 4 in. by ⅜ in. angle. The end plate is formed of an angle and is horizontal between the two door posts, beyond which it slopes downward slightly to its connections with the side plates. The two inner end posts, or door posts, are heavy Z bars, while there are two intermediate channel end posts on either side of the car. All four of



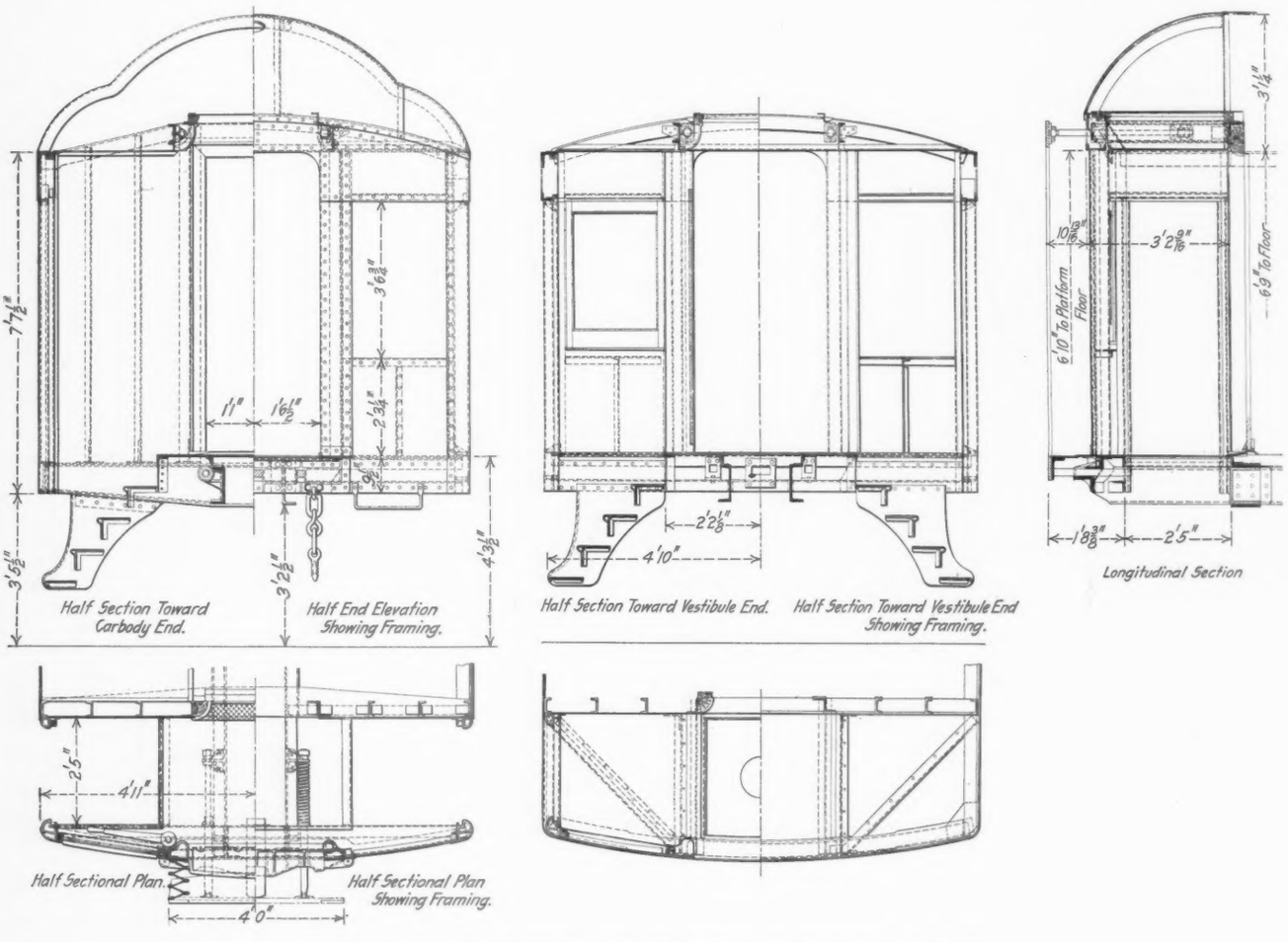
Cross Section Through Canadian Pacific Steel Coach



Floor Plan of the Canadian Pacific Steel Coach

these posts are riveted at the top to the end plate and at the bottom are riveted to the top of the end sill.

The platform end sill is a built up structure and is connected directly to the ends of the center sills which extend out under the platform. The vestibule door and corner posts are formed of special shapes and are connected to the platform end sill at the bottom and at the top to a channel extending across the car and connected at the ends to the extensions of the side plate angles. Diagonal braces also extend from the top of the vestibule door posts to the car body corner posts at the side plates, and the tops of the vestibule door posts and the Z bar end posts of the car body are connected by short channels. Above the channel which connects the vestibule posts horizontally at the top there is also an angle forming an arch extending across the car and connected to the channel by plates.


Half Section Toward Carbody End.
Half End Elevation Showing Framing.
Half Section Toward Vestibule End.
Half Section Toward Vestibule End Showing Framing.
Longitudinal Section
Half Sectional Plan.
Half Sectional Plan Showing Framing.
4'0"

Arrangement of the Vestibule of the Steel Coach on the Canadian Pacific

ROOF

The design of the roof used in these cars is unique in steel car construction. While it is in reality of the clerestory type it might correctly be termed a modification of the arch roof. The clerestory or upper deck itself is in the form of an arch, and the deck windows are arch shaped. The carlines at the ends of the deck windows are 3¼ in. by 1⅝ in. by 3/16 in. angles and extend between the side plates. Above the deck windows they are tied together at the ridge by 3¼ in. by 1⅝ in. by 3/16 in. angles. There is also a lower deck carline used between the two through carlines and the upper end of this is connected to a deck side plate formed of pressed shapes and extending between the through carlines. The roofing plates are 1/16 in. steel with tar paper placed between them and the carlines.

INSULATION

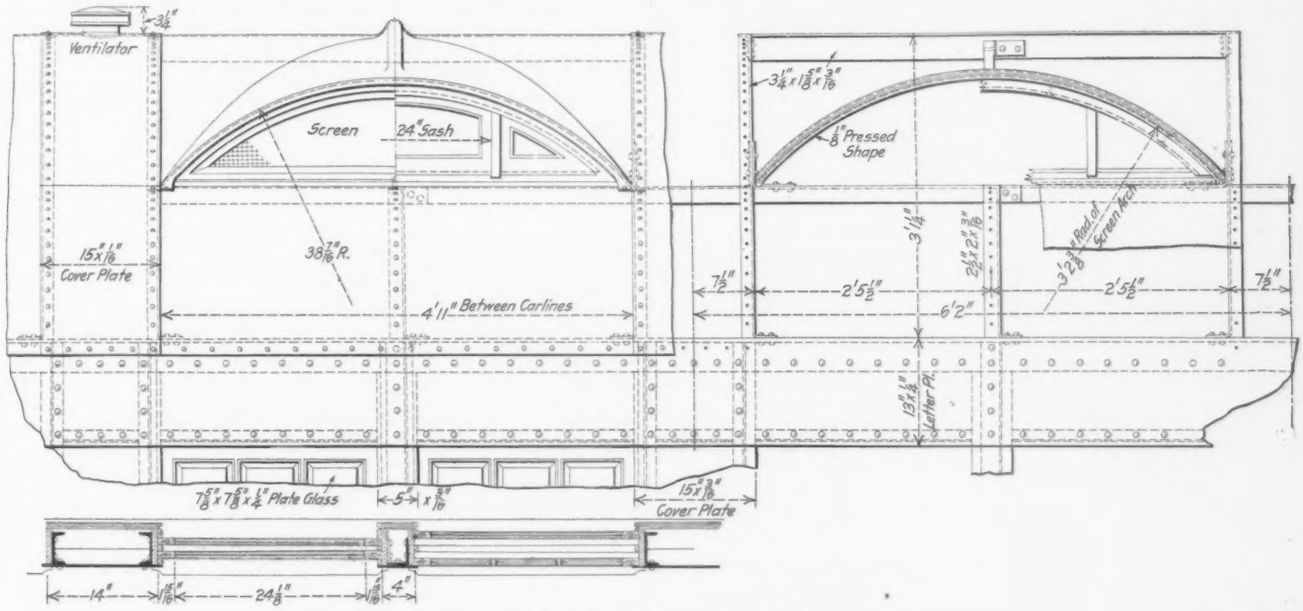
The insulation has been found to be quite satisfactory and makes the cars equally as comfortable as the wooden cars, even in the most severe winter weather. Directly on the 4 in., 5¼ lb. channels which extend from the center sills to the side sills and form the floor beams, there are placed No. 20 galvanized iron sheets with three-ply Salamander felt cemented to the upper side. Between this and the upper side of the floor stringers, which rest on the floor beams, there is left an air space, and on the floor stringers is placed ¾ in., 18 gage Keystone flooring. There is then a layer of cement and hardwood sawdust and a ½ in. layer of compressed cork completes the flooring. Three-ply Salamander is used in insulating the roof, while 2 in. cork is used in the side walls.

OTHER DETAILS

The headlining employed in the upper deck is Agasote, steel being used in the lower deck. The end doors are of steel. Wooden interior finish was used in the first cars, but a system of veneered steel interior finish has been satisfactorily developed and will be employed in future cars. This consists of a steel plate with a layer of canton flannel glued to both sides. Glued to this flannel is a layer of mahogany veneer, and in the case of colonist cars a final layer of birch veneer is used; in the first class day coaches this final layer is mahogany. This veneered steel finish can be bent to almost any shape any number of times without any detrimental effect. There is so little wood used that it is practically fireproof, so that the effect of a wooden interior finish is obtained with steel without the disadvantages of the latter.

The exterior finish is a mahogany color to harmonize with the natural wood mahogany sheathing employed on wooden passenger equipment on the Canadian Pacific.

The cars are fitted with long travel friction buffers and with friction draft gear, a short shank coupler being used instead of the long shank which is common in passenger equipment. The advantage of the short coupler, aside from eliminating unnecessary weight, is that it gives a greater side throw of the coupler head without increased carry iron clearance. The advantages of this were apparently for a long time overlooked by car builders, as the use of long shank couplers continued long after the building of cars sufficiently strong to carry the draft gear out near the end sill. The attachment of the draft sills or side castings at this point also reinforces the steel platform beams and increases the resistance to bending of the platform beams at the end sill.



Roof Construction and Section Through Side Windows

TESTS OF REFRIGERATOR CARS

To test the efficiency of refrigerator cars in the shipment of dressed poultry, and to determine the changes that take place in this poultry in transit at different temperatures, the Bureau of Chemistry, United States Department of Agriculture, has made complete examinations and records of 120 carload shipments of dressed poultry, which traveled an aggregate of 140,000 miles. The hauls averaged between 1,000 and 1,500 miles, and terminated generally in New York City. No car was used twice, and many different types of ordinary refrigerator cars were employed. The shipments were made in winter and summer, so that the effect of outside temperatures could be determined. As a result of this experiment it is stated that the builders of refrigerator cars have not kept pace with the refrigerating industry in general.

The experiments indicated that less than 31 deg. F. is the most satisfactory temperature for dressed poultry for long hauls.

The information furnished by these 120 car shipments indicates that most of the refrigerator cars of the United States are not built to maintain the best conditions during warm weather for the transportation of a highly perishable commodity, such as dressed poultry. Certain refrigerator cars are much more efficient than others.

The insulation of the car, in relation to temperature, is its most vulnerable part, with the character of the ice bunker next in importance. In the past the insulation has not been sufficiently heavy to maintain the low temperatures produced by the refrigerant, and the bunker has not been so built as to distribute its refrigerating effect evenly throughout the car. This last was fully established by the use of thermographs and the electric recording thermometers in various parts of the car. The use of a dead air space in cars is not found to be successful. Cork, the best known insulator, which is almost impervious to water, and contains practically no nitrogenous material which might produce decay, has not been used to any great extent in car construction. Wool and hair felt are good insulators, but their high percentage of nitrogenous material makes them good bacterial media when moist. These materials when once moist seldom dry out, and the result is putrefaction, giving rise to offensive odors, which contaminate goods. Some of the vegetable or cellulose fiber insulators are perhaps slightly more resistant to moisture and bacterial action, but in time they also become moist, and the alkalies present in such material hasten their chemical decomposition. It is for this reason that car builders are exerting every effort to prevent moisture from reaching the insulation. Mineral wool is least subject to decay, but is difficult to manufacture into strong material.

The insulation in the side walls and floors of the cars used by six different lines shows no radical difference in quality or quantity, though methods of construction in certain cases are preferable. The roof of the car theoretically is most severely taxed to prevent transmission of heat. The most efficient cars studied were those with the best insulated and best built roofs. More attention should be paid to roof and floor insulation, and the latter more effectively protected against moisture.

The wire-basket principle of ice bunker is sound because abundant air access to ice and salt results in increased efficiency. A serious shortcoming of the present types of cars is the impossibility of equalizing the temperature at the center and at the bunker so that all parts of the car are sufficiently cold. Good bunkers and any additional insulation, together with the stowing of the load so as to provide passages for cold air between packages, should materially help to improve results. The well-cooled package does not show changes in temperature corresponding to those in the air of the car, but a long continued increase of temperature or direct contact between the package and the wall of the car, and therefore the source of heat, affects the goods in the course of time. It is the constant or maintained rise in the average temperature of the car that is responsible for objectionable results noted at the expiration of long hauls.

SHOP FOR STEEL CAR CONSTRUCTION

Use of Steel for Canadian Pacific Freight and Passenger Equipment Necessitated the Plant

The Canadian Pacific now has in service over 30,000 steel frame box cars of the type described in the Railway Age Gazette, May 10, 1912, page 1050, and after some experiments covering two years with a steel car for passenger service, the road has decided to enter extensively into the use of that type of equipment. As it is the intention to carry out the construction of both the steel passenger equipment and the steel frame box cars mainly at the Angus shops in Montreal, a new shop building has been erected for this purpose.

The building is a brick-steel-glass structure with a rectangular body having an extension at one end, as shown on the plan. The width of the main building is 182 ft. and its length 402 ft. 6 in. Beyond this there is an extension having a length of 202 ft. 6 in. and a width of 72 ft. This extension is used for the assembling of freight cars and has a capacity for 10 cars at one time. The erecting portion of the passenger car shop will hold eight cars.

The Shop is Exceptionally Well Lighted; Spacing and Punching Machines are Shown in the Foreground

The shop is well lighted. The windows occupy about 26½ per cent of the side wall space, in addition to which there is a series of ventilated skylights 14 ft. wide extending for nearly the whole length of the building and spaced 27 ft. from center to center, giving a skylight area of 51.1 per cent of the total area of the roof. The general character of the steel structure is shown by the engravings.

The main crane equipment consists of three traveling cranes of 100 ft. span each and one of 70 ft., the capacity of each being 10 tons. Of the three cranes of 100 ft. span, two are within the building and the third is outside at the end of the midway. In the general arrangement of the Angus shops there is a broad midway or drive dividing the shop scheme into two parts. This midway is spanned by a traveling crane which traverses its whole length. Its runway has been extended to overlap the runway of the outside crane of the steel car shop, so that it can deliver material to this shop. All three of the 100 ft. cranes have a travel across the shop, for reasons explained later, while the 70 ft. crane travels parallel to the general movement of the work and material.

The building was started on April 1, 1913, and five months later, September 1, the first car was turned out. By the end of October eight cars per day were turned out, and this output was subsequently increased to twelve per day, working eight hours only. The shop was designed for a capacity of ten freight cars per day, in addition to the passenger car work, but it can be operated up to fifteen cars per day without difficulty.

The tool equipment for the freight car work consists of:

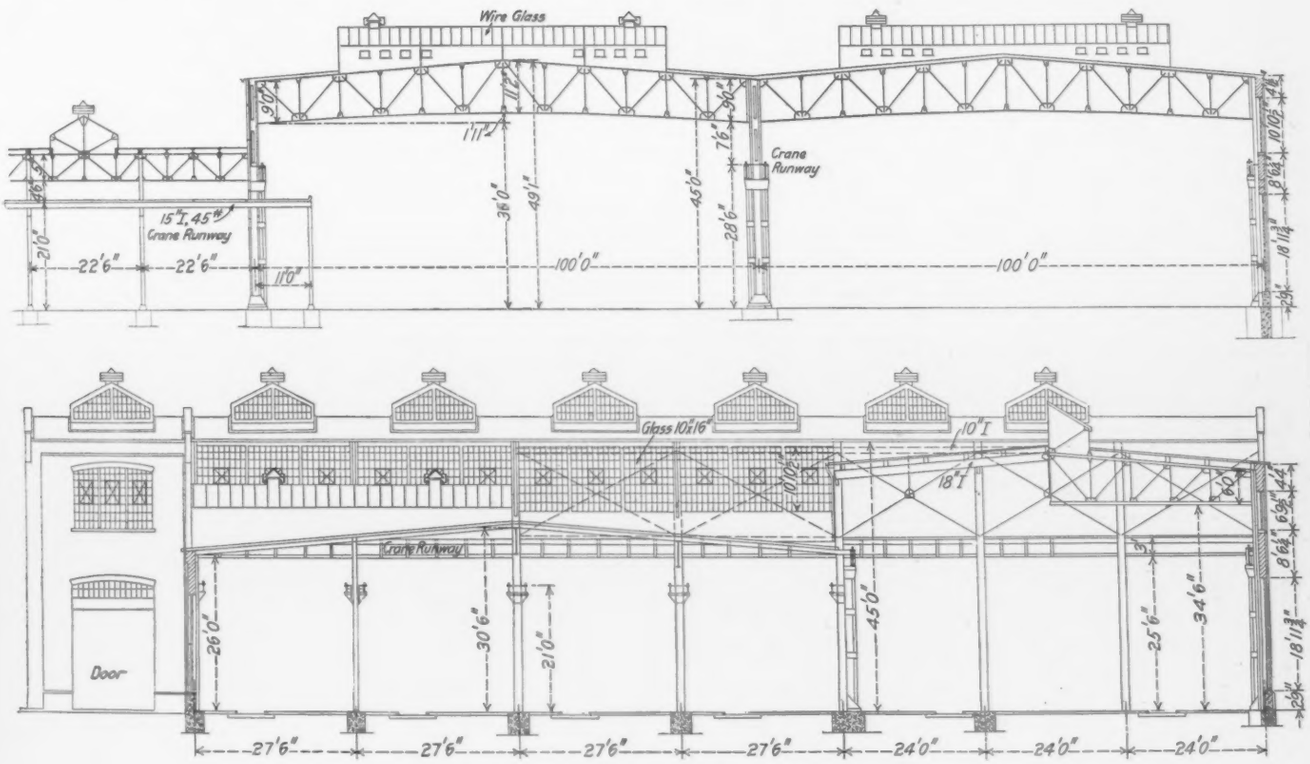
- 5 spacing machines for use in spacing the punching of holes in the webs and flanges of center sills, for small Z bars and angles, and for Z bar center sills
- 3 high speed punches
- 1 coping punch
- 1 coping punch for center sills
- 1 assembling template for end frames
- 1 assembling template for side frames
- 1 assembling template for underframes
- 1 storage rack for Z bar center sills
- 1 storage rack for floor stringers
- 1 storage rack for side plates

1 storage rack for center sills
1 storage rack for side sills

For the construction of passenger cars the equipment consists of:

1 assembling template for underframes
1 coping punch
2 high speed punches
1 coping punch for center sills
1 set of plate rolls
1 spacing table for plates
1 plate planer
1 plate shears
1 spacing table for belt rail
1 transfer table

In addition to the above there are a number of rivet heating furnaces in the assembling portion of the shop, so located as

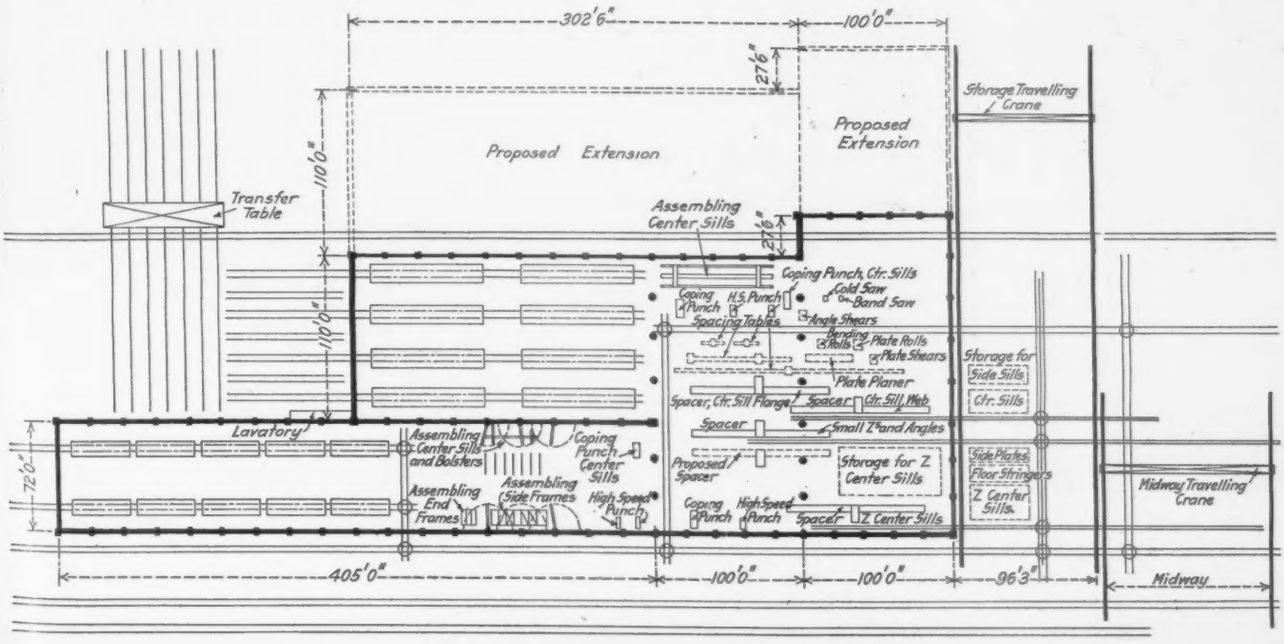


Sections Through the Canadian Pacific Steel Car Shop

1 angle shears
1 metal cold saw
1 metal band saw
2 spacing tables for roof plates
1 set of bending rolls for roof plates

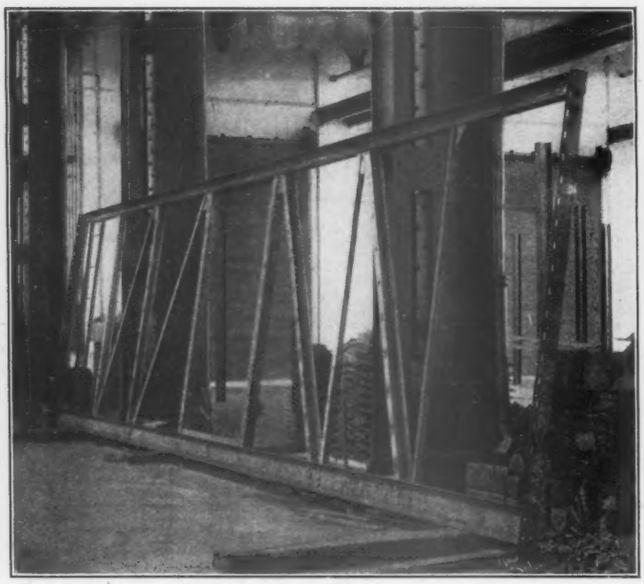
to be convenient to the work. Oil is the fuel used in every case. The tools are all located in the main body of the shop as indicated on the plan.

The fundamental idea followed in the passage of the material



Plan of the Canadian Pacific Steel Car Shop

through the shop is that of having it travel on one course from its entrance as shapes, cut to length, to its exit as finished material in the form of a car. At first sight it seems strange that the travel of the two 100 ft. cranes should be at right angles to the course of the material instead of parallel to it. The reason for this is that it is often necessary to carry material across the shop from one tool to another, while the movement in the general direction of rough material to finished car is effected by the passage through the punching machines themselves. Thus, for example, the shapes enter at the north end, are carried to the punches in the first bay and are moved on through them to the second. Here the transverse crane carries them to the next machine and the punching is completed.



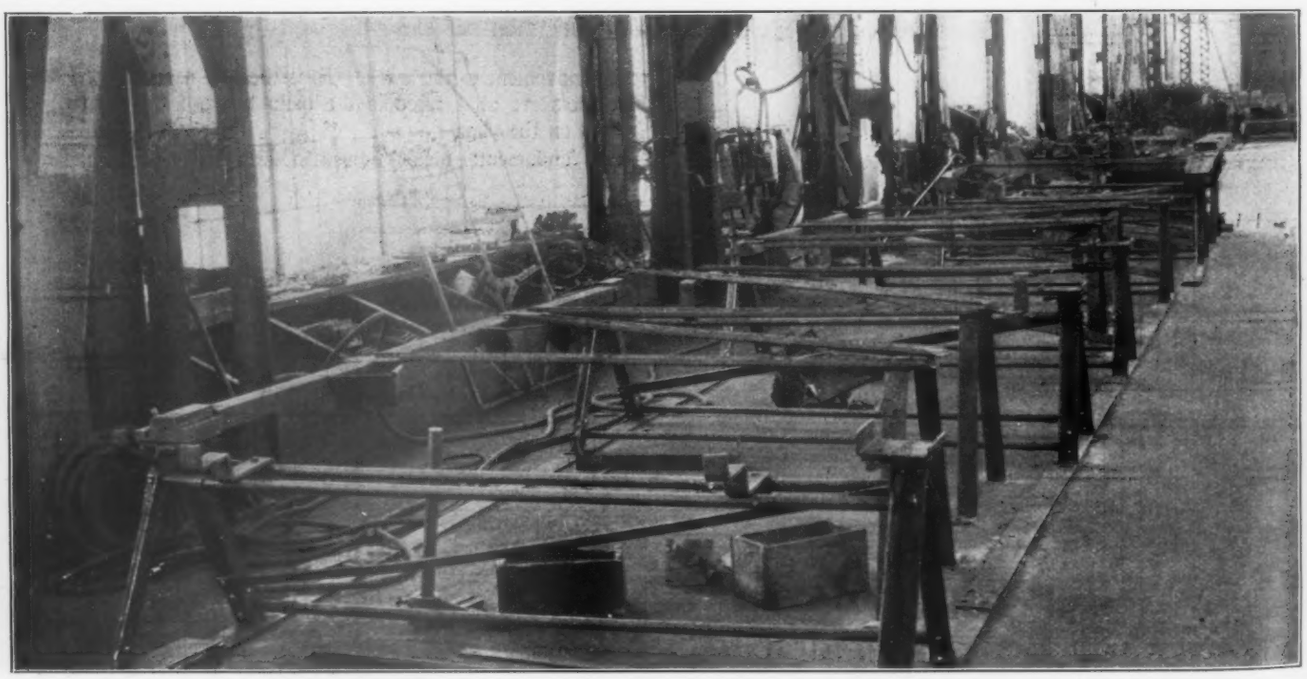
A Side Frame Ready to Go to the Erecting Frame

With the spacing machine a single template bolted to the side of the rack by which the machine is moved is all of the laying out required. This consists of a strip of wood with steel pins projecting from it at proper intervals. The stop of the spacing machine strikes one after the other of these pins and, as it drags after it the shape which is being punched, it stops the latter at the exact spot under the punch where the holes are to be made.

Erecting Frame Used for Freight Cars

The work done is very exact and all parts are thoroughly and perfectly interchangeable.

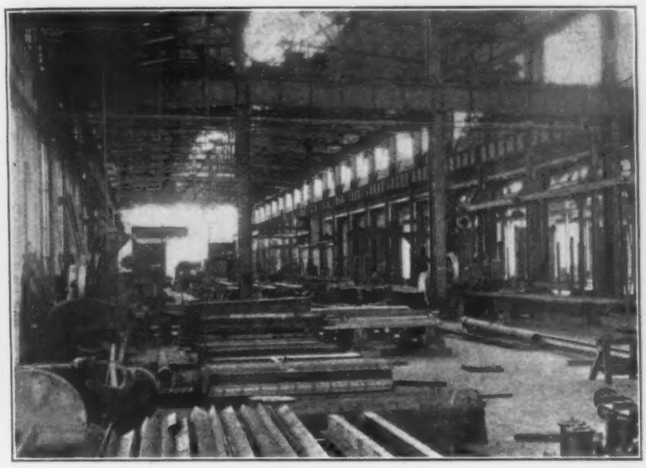
For punching the short pieces, a simple method of spacing is used. The punch is kept running continuously and leading out from one side is a bar in which holes are drilled to correspond to the spacing desired in the piece to be punched. One man drops a drift into the hole nearest the punch, and the helper, on the other side, pushes the shape against the drift. The punch comes down and makes the first hole. As it rises the drift is shifted to the next hole and the piece brought against it, when it is in place for the second hole, which is punched by the downward motion. Again the drift is shifted with a repetition



Template for Setting Up Side Framing; the Pockets are for Holding Tools

of the other motions until the work is done. These holes are punched in the lighter parts at the rate of about 36 a minute.

The underframes are assembled on one side of the erecting shop and the side frames on the opposite side, with the stock of parts required for each piled on the floor between, thus making the material accessible for both gangs and admitting of the bringing in of additional material without interrupting or



General View of the Freight Car Erecting Floor

interfering with the work. For the side frames there is a series of racks on the floor in each of which the several vertical and diagonal braces are kept separately. Nearby there is a horizontal jig or template on which the whole side frame is assembled. On this template the sills, plates, braces and posts are laid in place and brought into adjustment by drifts and cotter drifts, very little bolting being used. The cotter drift is merely a drift with a hole for a flat wedge cotter at one end, to hold it firmly in place. When the whole frame has been put together it is riveted on the template before being taken to the erecting frame.

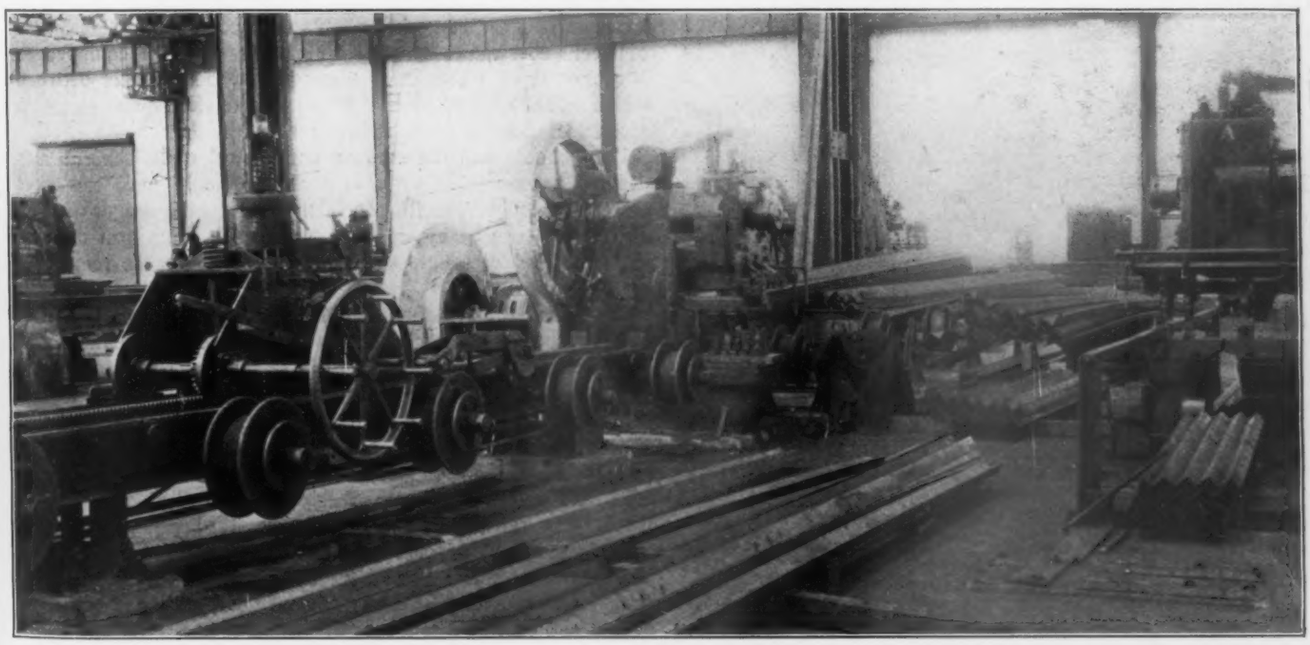
The underframing is assembled in substantialiy the same manner. The center sills and cross bearers are assembled on stationary iron pedestals that are arranged to properly gage the location of the several parts and the frame is then moved forward to another similar assembling table, where the side sills and other parts of the end framing are added and the whole riveted up. In the case of the cover plate for the bolsters, and some other of the bent parts, the holes are punched in them and the pressed steel webs; but, as both of these parts are apt to be irregular, due to the process of forming them, they are clamped together with screw clamps and drifts, and then all holes are reamed to fairness with an air driven reamer.

With the side and underframing assembled separately in this way, the latter is run forward on its trucks under the erecting

Freight Car Erecting Shop Showing the Erecting Frames in the Background

frame, over which there is a traveling crane, running parallel to the tracks, as at this point the manufacturing has been completed, and the work consists of handling the material forward for erection. The whole process is exceedingly simple, and the shop is exceptionally free from litter at all times.

Under the erecting frame, the side and end framing are lifted to place on the underframing by the overhead crane, being first bolted and then riveted. As the underframing is placed on the trucks before this is done, the completed skeleton of the box



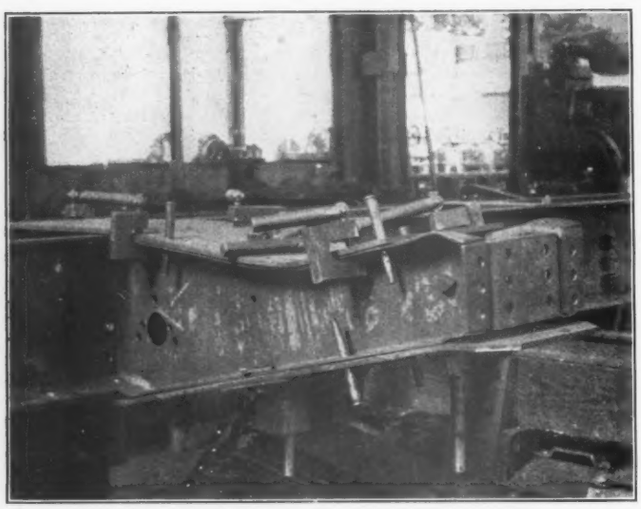
The Machine at the Left Draws the Piece Through the Punch and Automatically Stops It at Points Where Holes are to be Punched

car is ready to be hauled to the woodworking shop for the application of the sheathing, floor and roof as soon as the riveting of the frame is completed. It is run out, painted by spraying and then sent to the woodworking shop for completion. However, the type of metal roof now being applied on a small order is placed on the car in this shop and the steel sheathing of pas-

Runway for the Outside Traveling Crane

senger equipment cars is, of course, applied there, the cars afterward being transferred to another shop for finishing.

The erecting frames for both the passenger and freight cars are similar. Those for freight car erecting consist of a frame supported by six lattice columns and fitted with a runway for a small overhead traveling crane, by which light material is han-



Setting Up an Underframe, Showing Clamps and Drifts in Place

dled. They have a length sufficient to accommodate two cars and are provided with a scaffolding on each side for the accommodation of the workmen.

VENTILATING THE UNDERGROUND.—Under the old method of ventilating the tunnels of the Underground railways in London, the air was withdrawn by means of an exhaust fan. By the device now being installed at the Edgware Road, Euston, and at the new Embankment station, unlimited supplies of air will be pumped into the tunnels throughout the day and night. Ordinary air is passed through a washing screen which extracts all impurities, the requisite humidity is next imparted, a proportion of ozone added, and it is then sent into the stations at the rate of 25,000 cu. ft. per minute.—*The Engineer.*

REINFORCING OLD WOODEN FREIGHT CARS

BY W. M. BOSWORTH
Mechanical Engineer, Louisville & Nashville, South Louisville, Ky.

The reinforcing of old wooden cars of 60,000 and 80,000 lb. capacity with steel underframes and heavier draft gears is giving some railways a great deal of concern, while others have not given it the attention which it demands. It is useless to apply new roofs to such box cars, which are used in heavy trains with steel cars and get the same rough usage in hump yards, and expect the new roof to be at all times water tight and protect the lading, unless a steel underframe is applied. It is also useless if the car is turned out after repairs with the old wooden draft timbers and the light spring draft gear so prevalent in old wooden equipment.

Box cars should preferably have an entire steel underframe, which will eliminate the truss rods and the variable amount of camber, as it is this camber which causes strained and leaky roofs when cars are roughly handled, with a consequent damage to the lading. The side doors and fixtures will also give the best results on cars which have the steel underframe, with truss rods omitted.

The re-application of wooden draft timbers and the light gear is much the same as throwing so much money away, as the cars are in service only a short time before another set of timbers is required and the draft gear needs attention. If an all-steel underframe is prohibitive on account of cost, the car should be equipped with steel draft arms, connected by steel center sub-sills with the neutral axis as near the center line of draft as possible to take the shock and minimize the strains on the roof. With a steel underframe or center sills, a good friction draft gear, reinforced ends if needed, substantial side door fixtures and a good flexible outside metal roof, there are thousands of wooden box cars which could be made serviceable for the next ten years or more, with the cost of maintenance reduced to a minimum. Older box cars which would not justify the expense of steel underframes or steel center sills, could be equipped to advantage with metal draft arms with wood sub-sills between which would keep these cars from going to the repair tracks on account of wooden draft timber and bolt troubles.

For gondola and flat cars an entire steel underframe is not deemed necessary. Such cars could no doubt have the steel center sills omitted, and by applying a substantial design of steel draft arms with heavy wood center sub-sills from arm to arm, the draft timber trouble would be eliminated for the remaining life of the car.

The better wooden cars should also have an approved design of metal body and truck bolsters applied along with the other reinforcements.

DISCIPLINE ON THE LONDON & NORTHWESTERN.—A bulletin showing the list of fines administered to various mechanical employees on the London & Northwestern, dated August 25, 1892, and signed by F. W. Webb, superintendent, shows how careful this railway was in maintaining its discipline. Enginemen, firemen and cleaners were fined nominal sums for various causes from passing signals set at danger to smoking in the shop. The maximum fine was about $5 for passing a signal at danger and causing a mishap. The smallest fines were two shillings and six pence, or about 60 cents; these latter fines were levied for causing smoke nuisance, smoking a pipe in a shed, causing damage to lubricator, being late out of the roundhouse causing delays to trains, overrunning passenger station platforms and for derailments due to carelessness. Other employees were dismissed for disregarding signals, for damaging the paint on an engine with a penknife, etc. At the present time a fireman will be laid off two or three days on account of wiping his engine over with paraffine oil, as it decreases the luster of the varnish.

SHOP PRACTICE

NOTES ON PRESENT DAY RUNNING REPAIRS*

BY W. E. DUNHAM
Supervisor Motive Power and Machinery, Chicago & North Western, Winona, Minn.

With the almost universal change in the type and arrangement of running gear and valve motion of the American locomotive that has taken place during the past few years, there has also developed a maintenance situation that calls for a considerable reorganization and rearrangement of many divisional shop forces.

On some roads where it was considered that a locomotive should receive a general overhauling once a year and one intermediate heavy repairing as well, we find that the time between the general repair shopping has been extended to two years, and that the intermediate repairs are made in the roundhouse as running repairs. Where 75,000 miles was the limit for giving a passenger locomotive a general overhauling, many of them are now making 150,000 miles between shoppings and a similar proportion is resulting in the case of freight power. In fact in some "good" water districts the boiler is now the controlling factor in shopping rather than the machinery, as was formerly the case. To meet this situation there naturally has arisen a tendency toward spreading out of shop facilities rather than concentrating them at one or a few points.

There is a large shop economy in the outside valve gears with their pin and bushing connections that are readily accessible, easily renewed and open at all times to close inspection. No shop or roundhouse man who has handled both the inside and outside gear, would ever be in favor of discarding the present outside gear for the old inside. With this striking example before us, it is desired to call attention to locomotive design in general and in some detail where it is believed considerable economies can be obtained if the matter of the care of running repairs is given close attention.

The care required to keep up the pin connections of driver brake rigging, particularly in the numerous levers and hangers, is no small bug-bear to the average roundhouse foreman. If the rigging is originally constructed with standard bushings and pins throughout, it is easy to understand the ease and promptness of making repairs by going to the storekeeper, getting a new standard bushing and a new pin and pressing the old bushing out and the new one in place in one operation. In many instances the parts would not have to be taken down, as repairs could be made in place, with proper tools. It is no doubt true that the first cost of a fully bushed brake rigging would be much in excess of the present generally used design; however, when taking into consideration the large amount of repair work constantly needed on brake rigging, and the amount of blacksmith shop work required to restore, and in many cases renew the various parts of the rigging at the time of shopping, it would appear to be a self-evident fact that the additional original cost would soon resolve itself into a large economy during the whole life of the locomotive.

What has been said regarding pins and bushings in the brake rigging applies with equal force to spring rigging. We also find very few, if any, spring riggings and brake riggings put up with or arranged for any lubricating facilities at the bearings. A roundhouse man who systematically oils these parts as best he can, knows from the practical results obtained that he is saving considerable labor and material. A single trial of oiling the spring rigging will invariably convince the most skeptical that there is a large shop economy in the plan, and also an easier riding engine. If all the larger bearings, at least, were originally equipped with simple oiling facilities, a considerable economy in wear could be expected.

On a great many roads it has been found to be a very desirable practice to change driving tires for re-turning instead of dropping the wheels and turning the tires on the original centers. Where such a practice is in vogue, particular attention should be given to the necessary clearance around and in front of the wheel centers, to permit the tires to be heated and removed with the minimum amount of stripping of other parts of the locomotive.

On any line where there are a large number of curves, and frequently the combined feature of grades and curves, the matter of lateral wear of the engine and trailer truck wheels and drivers is of great importance. As large a hub face and box face as possible is a very desirable detail. As an example of following old proportions, I have in mind an engine truck detail where a box with a 14 in. over-all width dimension is used. The axle has a 6 in. wheel fit, and the wheel has an over-all hub face diameter of 11 in. The natural result of wear is that the 11 in. hub bores a hole in the face of the box and the box usually comes to the shop as scrap. The life of this hub and the box could very easily be extended considerably if the wheel hub face was made 14 in. in diameter, and thus get the full benefit of the entire face of the box as it now exists, increasing the bearing surface fully 100 per cent. In addition to this there are the four corners of the box which would receive no wear and which could be brought into play by a hub or wearing plate, even larger than 14 in. in diameter.

In the case of the trailer trucks, the designer is not limited by any recommended or standard practices and can readily give full consideration to the subject of lateral wear. With the prevailing tendency, however, to reduce the weight of steel castings, the hub face has usually come as a second consideration. Naturally, the strength of the hub to safely withstand the axle pressure fit, is the primary consideration, and as a result, the hub face has been usually taken as a sequence to that consideration instead of being one of the primary details. A hub face on a trailer that is small will, the same as with engine truck wheels, result in excessive lateral wear in a very short time. In some instances under local conditions this lateral will require attention as often as once in six weeks or two months, whereas six months would not be unreasonable to expect the locomotive to run without developing excessive lateral.

In addition to the consideration of bearing area in lateral detail, there is the subject of readily maintaining this lateral within the desired limits, without sending the engine to the back shop. Removable or adjustable hub liners and box face liners for engine and trailer truck wheels and for drivers have been schemed out with apparently indifferent success. In too many instances the poor results obtained were due to the light construction of the parts, which soon broke in service and were lost out, making the resulting condition worse than the one which it was endeavoring to correct. A substantial liner, easily and firmly secured in place and capable of being prepared in advance to the proper thickness to take up lateral wear, can no doubt be adapted to all older as well as new power.

With all the driving axles on the modern outside valve geared engines free of obstructions between the frame, there is a strong reason for considering having the driving box brasses held in position by keys or locks, rather than a pressed fit, so that new brasses can be applied to the boxes in the roundhouse, without dropping the wheels or sending the engine to the shops. For other than main drivers, some roads are reported as having fitted

*Abstract of paper read before the Western Railway Club, April 21, 1914.

up the brasses for rolling action only, using a slip brass with a crown fit of somewhat the same type as the usual engine truck box brass. With generous main brass bearing and sufficient shoe and wedge surface, this plan would appear to be a perfectly reasonable one and worthy of careful consideration. Knowing as we do that with the main boxes and brasses closely lined up the other driving boxes and brasses can and should run with the wedges down somewhat and the journal brass fitted a little loose, would it not be reasonable to start out with a design to suit that condition?

Solid end main rods are meeting with favor where tried. The elimination of the strap bolts is no small gain to the roundhouse man and "file main rod brasses" does not mean so much of a job for him as it did when he had to knock out a lot of strap bolts, possibly destroying one or more in the operation and at all times be very uncertain as to when he could expect the job to be done. Instead of letting it go another trip because he was particularly rushed that day and did not want to get tied up on a hard job he now cleans it up when first reported.

"Examine packing; both sides blow," means a lot of work just to find that lubrication was not good or that there was some other minor defect and that broken or worn out packing rings was not the trouble. A lengthening of the piston rod so that the piston head would come outside the front end of the cylinder without disconnecting the crosshead fit, would help materially in such work and also avoid disturbing a connection that should be left alone as much as possible.

Another feature of the piston rod and head detail is the use of a built-up type of head in which a bull ring is arranged that can be renewed to suit the wear or reboring of the cylinder without the necessity of applying a new piston head and disturbing the piston and head fit. The roundhouse can thus readily keep the piston head true to the cylinder with minimum expenditure of time and labor.

Where the eccentric and straps of the Stephenson link motion are still in use, a liner of brass or special wearing metal for the strap means a lot of time saved in curing a "lame" engine. These liners, when kept in stock all turned and bored for a quick application, assist the roundhouse man materially in overcoming lost motion and keeping the locomotive square.

The bearing surfaces of crossheads are ordinarily made of such a shape and secured in such a way that the taking up of the wear usually means dismantling the crosshead or disturbing the guides. The latter is a prolific cause of piston packing troubles, in that the guides are not always again set up true to the cylinders. With the numerous examples of substantial crossheads used in stationary practice that have ready and practical means of adjustment for wear, it would seem as though our locomotive practice should develop a scheme for taking up the crosshead wear that would be practical and satisfactory. There is no doubt but that the general adoption of some such scheme would save much roundhouse labor and overcome very many of the annoying steam leaks in the piston packing.

For any part of the country where the water is of the quality known as "good," that is, where there is no accumulation of scale on the flues or deposit of mud or sludge in the boiler, there is no doubt but that the welding of all of the flues in the flue sheet would be entirely successful. Most of us, however, are not blessed with such ideal conditions. The water we are using is generally heavily charged with incrusting solids and has large amounts of mud in it, which form deposits on the flues and usually at the most inaccessible points of the boiler. At the same time we are laying out our flue sheets with the flues staggered the same as we did years ago, with the fond idea that it is the most efficient plan for permitting the generated steam to rise through the water with the least amount of resistance. Should we not lay out these flues with the principal thought in mind as to how the boiler washer could get at each flue and get the scale down and out without forming a bank? With the information given us in a fully authoritative manner that the flue heating surface is of secondary importance to the fire-box heating surface, should we not more thoughtfully consider the matter of facility in washing out when laying out flues?

The author cannot but believe that if considerable care and attention are given in advance to the details connected with the several parts of the locomotive that usually wear out of shape and proportion, there will be large returns in the lessening of delays incident to the making of repairs.

DISCUSSION

While this paper was not discussed as thoroughly as the subject might demand, it was clearly pointed out that while the roundhouse workmen might find it difficult to make repairs on account of the design of engines, it was often necessary in specific cases to disregard the repairman's viewpoint in order to obtain the design necessary to give the most economical operation. The universal welding of the flues in the tube sheet was questioned in that, especially in bad water districts, it would be an absolute waste of money to do this, as the tubes would become pitted to such an extent that the tube itself would fail before it began to fail in the tube sheet, thus making the welding a superfluous operation. On one road, it was stated, difficulty has been found in maintaining the large superheater flues in the flue sheet; it was afterwards found that they were originally put in holes much too large for the tube, the joint being made by the use of shims. It was suggested that the large flues be swaged down to a slightly smaller diameter, and then rolled into the flue sheet. This practice, it was stated, has given specially good results.

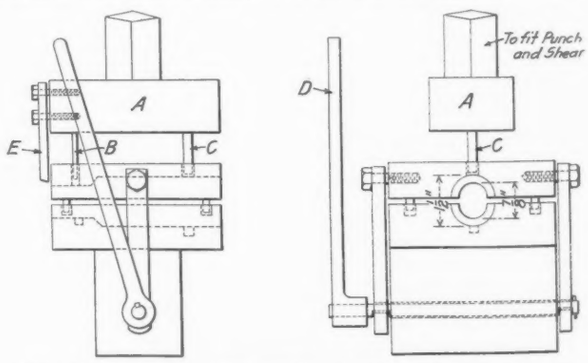
As regards removing wheels or tires on account of flat spots, instances were mentioned where these flat spots, ranging from 3 to 6 in. in length, were repaired by the oxy-acetylene process, chips from the wheel lathe being used as the flux. On the Chicago, Milwaukee & St. Paul this practice has been performed at an average cost of about $8 per engine, for 15 engines.

PUNCHING HOLES IN BRAKE STAFFS

BY R. F. CALVERT

The tool shown in the accompanying engraving has been in successful use at the Horton, Kan., shops of the Rock Island lines for about three years, for forming and punching holes in brake staffs. With the use of this die it is possible to turn out from 200 to 250 brake shafts an hour.

The device is used with a punch and shear. Block *A* is made to fit the machine, and on this there are placed two punches 5¾ in. apart, one of these being 9/16 in., and the other 5/16 in. On



Die for Forming and Punching the Ends of Brake Staffs

the end of this block is fastened a shear blade as shown at *E*, for cutting the staffs the proper length. The two halves of the die proper are, when a staff is being inserted, held apart about ½ in. by means of the lever *D* and the connecting links and eccentric shaft. A staff is heated to a red heat in a furnace and then the end is placed in this die. The lever *D* is then pulled down, closing the die and at the same time forming the end.

AN EFFICIENT PIECE WORK SYSTEM

The Methods in Use at the Angus Shops Have Produced Good Results Without Going to Extremes

Without adopting the extreme methods advocated by some of the efficiency experts, the Canadian Pacific has installed at the Angus shops, Montreal, a piece work system which makes use of some of the best of efficiency ideas, but which has been worked out on a practical basis as indicated by the needs of the shop. The system has been most successful and has resulted in an increased shop output and a substantial reduction in cost per engine repaired. The men are guaranteed the amount which they would make on day wages and are, of course, paid anything which they make above that amount.

The work of supervision, and the making of instruction cards, time studies and the fixing of prices, is looked after in the office of the piece work inspector, where are located also the auditing department clerks, who distribute the proper time against the different shop operations. In certain sections of the shop the distribution is made by personal observation of the work and time, by men known as time in-

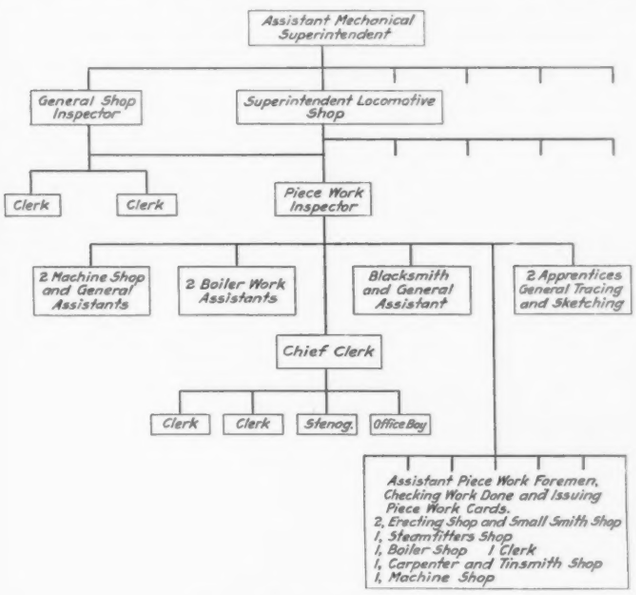


Fig. 1—Organization Chart

spectors, to whom are assigned a limited portion of the shops containing not too great a number of workmen for the inspector to handle.

The chart, Fig. 1, shows the piece work inspector's connection with the main organization of the shops and the arrangement of his staff. This office is the chief one for the establishing of standard shop practices and it is connected through the general shop inspector with all other repair shops on the company's lines east of Fort William. The staff may appear large, compared with those of some of the repair shops in the eastern portion of the United States, but the cost is small when the total amount of wages distributed on a piece work basis is considered.

When a price is required for doing any piece of work the foreman sends to the chief piece work inspector the piece work price request shown in Fig. 2. The request is then turned over to a demonstrator, who, when he has made a price for the job, fills out the reverse side of the price request, Fig. 3. If sufficient information is not at hand on similar work, the demonstrator goes to the machine and makes a time study of the work, filling out an instruction card like that shown in Fig. 4.

In making the instruction card, 10 per cent is added to the theoretical machining time and 20 per cent to the actual time of handling in the case of each detailed operation. The number of cuts and the number of pieces per hour are also taken into consideration and allowances made for the skill and amount of labor required to do different classes of work, and for the extra time required in setting up the work the

CANADIAN PACIFIC RAILWAY COMPANY
ANGUS LOCOMOTIVE SHOPS
PIECE WORK PRICE REQUEST

Mr. J. Doe — P. W. I. — 191 3/9/14

Name of part: Driving Wheel Tires
Operation: Turn Treads and Flanges

List No.	76L676	Drawing No.	76L676
Classes	All	Machine	L.W.7
Engine No.	2450-59	No. of pieces	One Pair
Store Order No.		Man's Name	P. Smith
Material	Krupp Steel	Man's Rate	35¢
Remarks			

Signed P. Smith — Foreman

Fig. 2

first time, the result being a reduced time allowance after the first piece in certain work.

From the instruction card the demonstrator then fills out the opposite side of the piece work price request, Fig. 3, showing the price to be paid for the operation. The price request is then returned to the chief piece work inspctor with the instruction card and if satisfactory the inspector signs the price request and returns it to the foreman for his approval and signature. The instruction card is filed and there are made out from the request four cards like that shown in Fig. 5; one of these is sent to the office of the superintendent of locomotive shops, one to the shop foreman concerned, one to the shop timekeeper and the fourth is filed in

SCHEDULE PROOF — SHOP SCHEDULE NO.

Name Tires Driving (New Work)

Dwg. No. 76L676 List No. — Price .45 Per Pair
Material Krupp S. — Equiv. Hrs. 1.28 — Gang or man rate .35¢
Machine L.W.7 — Classes All
Operation
Turn Treads and Flange of both wheels
Note: Wheels mounted on axles
Date 3/9/14
Checked by P. W. I.
Approved — Foreman

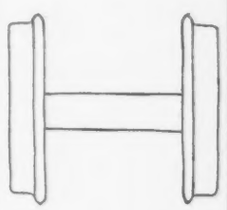


Fig. 3 (Reverse Side of Fig. 2)

the piece work inspector's office. If for any reason the price is not considered satisfactory, a red card is used, indicating that the schedule is temporary.

USING PRICES IN THE SHOPS

In keeping a record of the time in the machine shops, the form shown in Fig. 6 is used, the work of keeping the time being under the charge of the auditing department. No work order, as employed in connection with other work to be explained later, is given when this form is used, but the time

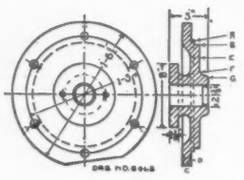
inspector is held responsible for recording the correct operation and price, as well as the time taken to do the work. The time inspectors remain in the shop and record the time as the work progresses. This form is used on all work whose nature is such that the men will not have to leave their particular shop or move about to any considerable extent.

When the work is finished the time inspectors complete all extensions and the form is then checked in the timekeeper's office and signed by the foreman. A carbon copy of this form is filed in the piece work office for reference.

DETAILED INSTRUCTIONS—(Continued)	Tool Used	Depth of Cut in Inches	Feed in Inches	Spindle R.P.M.	Speed in Feet per Min.	Minutes

TOTAL MINUTES
TOTAL HOURS PER PIECE

CANADIAN PACIFIC RAILWAY COMPANY
INSTRUCTION CARD LIST No. 64 L 34



NOTE:—DIMENSIONS ON SKETCH MUST NOT BE USED IN MACHINING. USE STANDARD DRAWINGS

Drawing No. 64 L 2
Name BACK PISTON VALVE COVER.
Class ALL CLASSES WITHOUT GUIDE LUG.
Schedule No. 64 L 190, 193.
Issue A
Operation
TURN AND BORE.
Operation No. 1 Material C. I.
Machine BULLARD VERT'L BORING MILL No. 74.
Tool Steel HIGH SPEED.
No of Pieces 1
Time 1.74 Man-Hours Per Piece
No. of Men 1
Pay Equivalent For
First Piece 2.63 Hrs.
Each Additional Piece 2.33 Hrs.
Date 5-12-10.

DETAILED INSTRUCTIONS	Tool Used	Depth of Cut in Inches	Feed in Inches	Spindle R.P.M.	Speed in Feet per Min.	Minutes
PREPARE MACHINE FOR 1st. PIECE.						18.0
1. SET UP AND CLAMP AND SET TOOLS.						12.0
2. ROUGH TURN CYLINDER FACE FIT. A	1 PRSD	1-4	1-16 H	8	29	5.0
3. " " SHOULDER. B	"	"	"	"	23	2.5
4. " " EDGE OF FLANGE. C	"	"	"	"	39	2.0
5. " " FACE OF FLANGE. D	"	"	"	"	35	5.5
6. SQUARE CORNER. B	1 PSWA	"	"	"	23	3.0
7. CHANGE TOOL.						1.0
8. TURN FACE E	1 PRSA	"	1-16	12	38	5.5
9. ROUGH TURN. F. G.	"	"	1-16 H	"	16	4.0
10. CHANGE TOOL.						1.0
11. FINISH TURN. F. G. (forming tool)	PSZ	1-32	1-32 H	"	16	2.5
12. CHANGE TOOL.						1.0
13. BORE VALVE STEM HOLE.	1 PRSE	1-4	1-32 H	"	10	4.0
14. CHANGE TOOL.						1.0
15. TURN BARREL FIT & JOINT FACE. A	1 PRSA	1-16	1-16 H	"	43	3.0
16. CALIPER AND CHANGE TOOL.						4.0
17. FINISH TURN BARREL FIT & SQUARE CORNER.	1 PSWA	1-4	1-16 H	"	43	5.0
18. REMOVE.						4.0
2nd. OPERATION.						
1. SET UP, CLAMP AND SET TOOLS.						5.0
2. TURN EDGE OF FLANGE. C	1 PRSD	3-16	1-16	8	39	3.0
3. FACE FLANGE.	"	1-8	1-16	8	35	8.0
4. FACE STUFFING BOX FLANGE	"	1-8	1-16	12	22	6.0
5. CHANGE TOOL.						1.0
6. TURN FLANGE EDGE.	1 PRSA	3-16	1-16	12	27	3.0
7. CHANGE TOOL.						1.0
8. BORE STUFFING BOX. (2 cuts)	PSZ	1-4	1-24	24	27	7.0
9. REMOVE.						4.0
					TOTAL MINUTES	104
D. H. ANGUS SHOPS.					TOTAL HOURS PER PIECE	1.74

Fig. 4

East Machine SHOP SCHEDULE No. 76 L 42
Name Tires, new driving wheel
Dwg. No. List No. Price .45 Per 2
Material Steel. Equiv. Hrs. 1.28 Gang or man Rate .35
Machine Class All.
Operation Turn Tread & Flange.

Date 11/20/12.4/09. Approved S.L.S.
P.W.I. A.S.M.P.

Fig. 5

When the work is of a nature that would make it difficult for the timekeeper to keep an accurate record of the time, the men record the time themselves on forms like that shown in Fig. 7. There are similar forms, of different colors, provided for mixed time, or part piece work and part day work, to cover conditions which sometimes arise, a straight day work card and an overtime card. The timekeepers check these cards with the number of hours worked as shown by the clock punch and the time and engine number are then transferred to the form shown in Fig. 8. In such cases the work order card shown in Fig. 9, which constitutes the authority for doing the work specified, is issued by the piece work foreman to the man doing the job, who turns it in to the piece work clerk at the completion of the work and the record is then transferred to Fig. 8. This form is then turned over to the foreman for signature, as in the case of Fig. 6.

In connection with Figs. 6 and 8 it should be explained that a piece work balance is a piece work balance is the difference between the amount made on piece work and the amount which would have been made if the man had been working day work.

Work which is largely done by hand, such as stripping, erecting, pipe work, etc., and which was formerly paid for

Serial No. of Card 8423
Shop WEST MACHINE
Name A. C. Brown
Clock No. 8133
Rate 35

CANADIAN PACIFIC RAILWAY COMPANY
M. P. TIME CARD

Form S. & M. A. 4 b
Issued Mo. 3/9 Day 1914
Completed Mo. 3/9 Day 1914

Charge	Number of Pieces	Description of Work	Schedule No.	Price Each	Hours Brought Forward	Date and Hours Labor Performed	Total Hours	Day Work Value	Piece Work Value	Hours to be Carried Forward	Total Piece Work Value per Contract	Total Piece Work Price	Individual Piece Work Value	Balance Over	Balance Short	% Performance	Joint Contract Card No.
3993	1	for D. W. Tires turned	76L42	45	9	1¼	1¼		44		45			01			

Fig. 6

in lump sums for large divisions of the work, has been divided into smaller details and prices provided for each. This has resulted in considerable saving and in increased efficiency. For work of this kind the chart of piece work prices shown in Fig. 10 has been developed and replaces the work order card shown in Fig. 9. A punch mark is placed opposite the work to be done. The use of this form obviates the necessity

CANADIAN PACIFIC RAILWAY COMPANY.
PIECE WORK TIME CARD

Following is a correct description and distribution of my Work and time.
Ci-dessous est la correcte description et distribution de mon temps et ouvrage. ______191___

Name______ Clock______ No.______ Rate______

Charge	Name of Part and Operation	Commenced Work	Foreman's Initials	Finished Work	Hours

Piece work hours checked by time inspector______
The distribution of time is correct______ VALUE OF CARD______
Foreman or Chargehand.

Fig. 7

(11-9-13-47602) FORM S. & M. A. 1.

Canadian Pacific Railway Co. *March 9* 191*4*

PIECE WORK ORDER CARD } Name *A. C. Brown*

East Mach. Shop Clock No. *8/133*

No. of Pieces	Description of Work	Charge to	Schedule No.	Price
1	*pr. D. W. Tires*	*3993*	*76 L*	*45*
			42	

______ Foreman.

Fig. 9

(19-3-13-41782) FORM M.P. 75

CANADIAN PACIFIC RAILWAY COMPANY
CHART OF PIECE WORK PRICES No. 50
ANGUS LOCOMOTIVE ERECTING SHOP

GENERAL REPAIRS
FITTING

Name ______ Engine No. ______
Clock No. ______ Issued ______
Completed ______

Pieces to be Repaired	Completed	Price	Amount	STRIPPING, MISC.
1		.50		Binders, pedestal, main frame, removed per pair of wheels
1		12		Binders, pedestal, trailing truck frame, removed per pair of wheels
				Rods, main and side with pedestals, and 1 pair of wheels removed
		1.25		Engine placed on pit jacks or blocks,
		2.00		Ditto., 2 pairs of wheels removed
		2.50		Ditto., 3 pairs of whels removed
		3.25		Ditto., 4 pairs of wheels removed
		.10		Rods, main, strap removed and replaced for machine shop, each
		.06		Rods, main, strap not removed and replaced for machine shop, each
		.10		Rods, side, with strap end, removed and replaced for m. shop, p. sc.
		.04		Rods, side, without strap end, per sect.
1		.06		Rods, main, with strap end, but strap not removed, per sect.
1		.30		Truck, pony (2 wheel), removed from engine, per engine
1		.15		Truck, pony (4 wheel), removed from engine, per engine
		.10		Pump, air, removed from engine, per engine
				CLEAN, TEST, ETC.
		6.00		Material, cleaned and distributed, No. 1 repair, } 105% and over
		3.00		Material, cleaned and distributed, No. 2 repair, } 105% and over
		3.00		Material, cleaned and distributed, No. 1 repair, } 100% and less
		1.50		Material, cleaned and distributed, No. 2 repair, } 100% and less
		.15		Frames, front and main Tested and examined, per side
		.04		Binders, pedestal Tested and examined, each
Total				Approved

______ Foreman

Fig. 10

(9-5-13-43196) FORM S. & M. A. 4

CANADIAN PACIFIC RAILWAY CO.

Shop Piece Work Record Card No______ Month of______191 Opened______191 Closed______191

Charge To	Schedule No	No. of Piece	Price	Amount	Name of Workman	Clock No	Date and Hours Labor Performed	Total Hours	Rate	Amount	Balance, Over.	Balance, Short.	Check
Total or forward							Amount / Wages / Balance			Total or Forward			

Correct ______ Foreman
______ Time Inspector

Value of this Card is indicated by the figures punched
$ 1 2 3 4 5 6 7 8 9 10 11 12 13
14 15 16 17 18 19 20 21 22 23 24 25
cts 10 20 30 40 50 60 70 80 90
2 3 4 5 6 7 8 9

Prices Checked by______ Entered by______ %______

Fig. 8

of looking up schedule numbers for all of the various items involved.

After the form shown in Fig. 8 has been signed by the foreman, it is sent to the office of the timekeeper, where the schedule number and price are checked and the percentage

CANADIAN PACIFIC RAILWAY COMPANY
ANGUS LOCOMOTIVE SHOPS
PIECE WORK DEPARTMENT
MONTHLY PIECE WORK REPORT
STEAMFITTERS. Shop Month ending Feby. 21, 1914.

NAME	OPERATION	No. of Contracts Closed	Total Contract	Total Wages	% Gain	% Loss
	Brake Cyls.	61	$ 45.32	$ 31.64	43	
	Strip Pipes.	28	40.30	36.45	10	
	Remove Pipes.	29	13.65	19.21		28
	Elec.Wiring.	35	93.22	78.30	19	
	Elec.Headlight	31	113.90	99.93	13	
	Cut 5" Tubes	23	54.37	41.10	32	
	Screw Nipples	12	53.40	35.70	45	
	Clean Valves.	21	32.08	28.48	12	
	contracts.	9	35.20	33.59	04	
	Repair Pumps.	4	12.80	10.34	23	
	Repair Pumps	14	65.75	57.37	14	
	Repair Pumps.	14	60.00	55.12	08	
	Iron Reprs.	6	102.14	123.35		20
	Iron Reprs.	2	38.24	36.31	05	
	Iron Reprs.	5	101.13	128.47		13
	Iron Reprs.	2	12.65	12.23	05	

Fig. 11

of the day work amount is calculated. Each man's balance is then distributed to the various accounts and all shortages for the month are deducted; the record is then transferred to the payroll.

(2-10-13—X125)

CANADIAN PACIFIC RAILWAY CO.
ANGUS LOCOMOTIVE SHOPS
PIECE WORK OFFICE

March 4, 1914.

Mr. Chief P. W. Inspector

The _____ Shop
presents below its "DAILY PIECE WORK REPORT"
for March 3, 1914.

No. of men on roll	214
No. of men working	194
No. of men absent	20
No. of men productive	148
No. of men non-productive	46
No. of men on supervision	5
No. of men clerical	1
No. of hours productive	1182 1/2
No. of hours non productive	414 1/2
No. of hours supervision	47 1/2
No. of hours clerical	9 1/2
No. of hours piece work	830 1/4
No. of hours day work productive	352 1/4
Tools and Machinery	39 1/2
Remarks	

Signed _____ Foreman

Fig. 12

PIECE WORK REPORTS

In each of the methods outlined, after the foreman has signed the form, the amount earned by each man is recorded on a card, which also shows the per cent gained or lost over day wages. For each shop there is also prepared a monthly piece work report like that shown in Fig. 11, from which the names of the men have been omitted. From this the shop officers

CANADIAN PACIFIC RAILWAY COMPANY
ANGUS LOCOMOTIVE SHOPS
PIECE WORK OFFICE
WEEKLY PIECE WORK REPORT, WEEK ENDING January 30, 1914.

SHOP	TOTAL EMPLOYEES		TOTAL HOURS		Per Cent of Regular Hours Accounted for		TOTAL PIECE WORK HOURS	Per Cent PIECE WORK PROD. HOURS			BEST RECORD	
	Pro. (1)	Non-Pro (2)	PRO (3)	Non-Pro (4)	Pro (5)	Non-Pro (6)	(7)	Present Week (8)	Last Week (9)	Same Week Last Year (10)	Per (11)	WEEK ENDING
BOILER	524	41	25852	1655	123	101	20456	79	79	79	90	12/27/13.
BLACKSMITH	134	20	5618	982	105	123	4413	78	79	76	84	8/2/13.
BRASS	67	9	2609	395	98	110	2062	79	84	78	84	1/23/14.
BOLT (4 days.)	19	3	800	127	105	106	527	66	65	76	90	3/7/13.
CAPTR. & TNDR.	47	14	1538	505	102	113	1111	72	69	70	82	12/6/13.
ERECTING	217	55	7720	2390	89	109	5440	70	75	82	87	5/24/13.
TENDER WHEEL	10	3	354	135	88	112	331	93	90	76	97	11/22/13
FROG	99	37	4245	1578	107	107	3519	83	82	80	93	5/6/13.
MACHINE EAST	139	62	5740	2620	103	106	4270	74	77	75	81	5/13/13.
MACHINE WEST	105	20	4273	913	102	114	2958	69	71	69	78	11/22/13
PAINT	22	3	884	115	100	96	884	100	100	100	100	1/30/14.
PATTERN	21	12	836	559	99	116						
STEAMFITTER	59	17	2481	798	105	117	1970	79	77	80	89	6/14/13.
SPRING & BRAKE	52	47	1987	1982	96	105	617	31	26	60	60	2/1/13.
TINSMITH	36	5	1308	197	91	98	1145	87	90	89	97	9/5/13.
ELEC. DEPT.												

Fig. 13

can determine at any time whether the productive efficiency is increasing, remaining stationary, or falling behind.

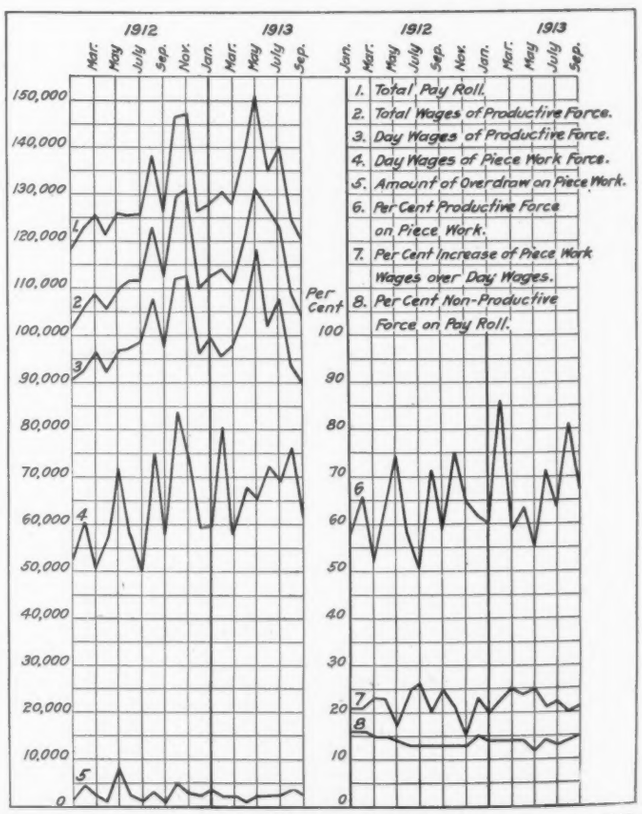


Fig. 14—Summary of Pay Rolls for All Shops from January, 1912, to September, 1913

Fig. 12 shows the daily report made out by the foreman of each shop. A weekly piece work report on an hour basis is also used and is shown in Fig. 13. It should be explained in connection with this form that all employees such as foremen, clerks, sweepers, etc., whose time cannot be directly distributed to the different accounts, are classified as non-productive. The report shown in Fig. 13 gives a great deal of valuable information to the shop officers, and is largely self-explanatory. In obtaining the figures shown in column 5, those in column 1 are multiplied by the number of working hours in the week and column 3 is divided by this result. Column 6 is obtained similarly from columns 2 and 4. Column 8 is obtained by dividing column 7 by column 3.

Fig. 14 shows in plotted form a summary of all shops from January, 1912, to September, 1913.

The idea in mind in arranging the system as described was to set piece work prices which were fair both to the men and the company. When prices are set by a busy shop foreman or a rate setter who has far too large an amount of work to handle to make an individual study of it, there are naturally a large number of rates which are not suited to the work, resulting in wrong distribution of labor and costs and much dissatisfaction on the part of a man when the class of work varies as it does in a locomotive repair shop. A viewpoint held is that prices that are fair for the man are those which will enable him to make a substantial increase in his wages in return for his best efforts, and that they are fair to the company when they are set so that a man must make use of all the advantages which are placed at his disposal, and is guided by the methods which are found to be the most economical.

The system of going into the work and making a study of it with the men has removed the distrust that is often present between the men and the officers of a company, and has at the Angus shops proved decidedly satisfactory to all.

GAGES FOR FLEXIBLE STAYBOLTS

BY L. BROWN
Demonstrator, Angus Shops, Canadian Pacific, Montreal, Que.

The illustrations show two gages for determining the lengths for cutting flexible staybolts. The use of these gages permits the bolts to be threaded and made ready for the boiler without any doubt as to their being correct in length, and also obviates the necessity of having to remove a bolt after it is screwed into place, because the length is not correct.

The jig in Fig. 1 has at *A* a circular part which is made to

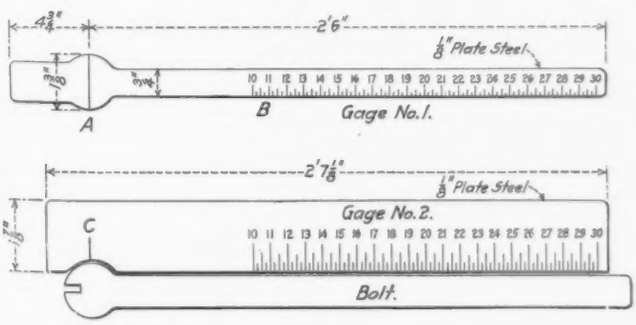


Fig. 1

suit the ball joint of the staybolt sleeve in which the staybolt head seats itself; above this is an extended end which is used as a handle. A line is cut across the center at *A* and from this point the gage is graduated, beginning at *B* and running to 30 in. in ⅛ in. graduations. The gage in Fig. 2 is made with a semi-circular piece cut out at *C* to receive the circular head of the staybolt which is to be marked for cutting.

In using the gages, an apprentice or a helper passes the graduated end of gage No. 1 through the staybolt sleeve until it rests on the ball, as in Fig. 2. The boilermaker, who is inside the boiler, notes the length necessary, and then marks the hole with a center punch or some convenient means of identification, and proceeds in the same way for as many holes as require bolts. After obtaining the different lengths required, gage No. 2 is used. The head of the bolt is placed in the ball at *C*,

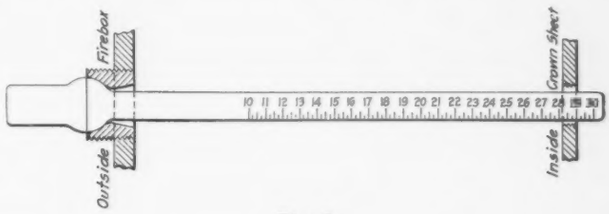


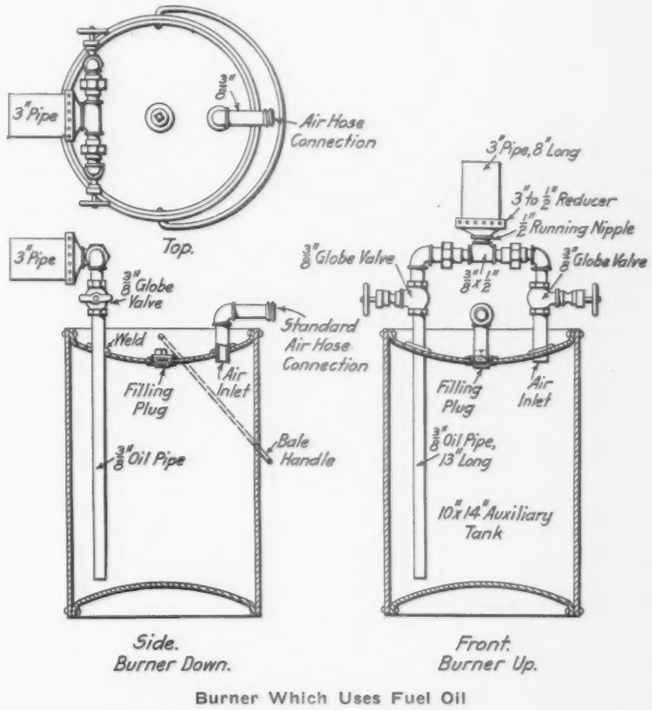
Fig. 2

bringing the stem in alinement with the graduations on the gage, and noting from the list whatever length is required, the bolt is marked where it is to be cut and stamped with the number of the hole. The bolts are then cut and threaded ready for the boiler.

FUEL OIL BURNER

BY H. E. BLACKBURN
Apprentice Instructor, Erie Railroad, Dunmore, Pa.

A portable fuel oil burner made of pipe fittings mounted on an auxiliary air reservoir is shown in the accompanying engraving. This burner weighs only 25 lb., and can be made at a very small cost. One of them has been in daily use in the car shops at Dunmore for over two years without causing any trouble. The burner is absolutely safe, for if the hose blows off



Burner Which Uses Fuel Oil

the flame will go out. It has been used in small and difficult places without any accidents, such as are sometimes experienced with a kerosene or a gasolene torch. The construction of the atomizer in the reducer is such that the air blast beats the oil into a spray. This spray is evenly discharged into the reducer where it ignites and spreads to the walls of the hood, causing a

whirling motion that generates the oil into a gas as it mixes with the air from the intake holes. The flame is of a high temperature, is readily controlled and will not easily go out.

A HOME-MADE POWDERED COAL PLANT

BY J. G. COUTANT

Considering the amount of thought that has been given to the use of powdered coal, there is but little authoritative and practical data available on the subject. Most writers seem to have the same opinions on certain points, among which may be mentioned the following:

The fuel must be very fine for economy; it is recommended that 95 per cent should pass through a 100 mesh screen.

The fuel must be dried, expelling all the moisture possible, and reducing the moisture content to less than 1 per cent.

Adequate means must be provided for removing the ash from the flues and combustion chamber.

The coal employed should contain very little sulphur.

The question frequently arises as to how serious these points are and how much they may be deviated from and the furnace still be practical. Variations occur, depending on the design of the furnace and whether it is used for high or low temperature work.

The writer has made several trials with a very crude pulverizer and furnace, under very unfavorable conditions, and some very interesting results were obtained.

Having found it necessary to consider a cheaper fuel, powdered coal suggested itself, but the question arose whether fuel of the

Fig. 1—Arrangement of Apparatus for Pulverizing Coal

following analysis, which could be purchased in the local market, would be suitable for the work:

American bituminous coal 12,932 B. t. u.—

Moisture	2.00 per cent
Volatile combustible	31.00 per cent
Fixed carbon	54.15 per cent
Ash	11.75 per cent
Sulphur	1.10 per cent
	100.00 per cent

Dominion bituminous coal 14,303 B. t. u.—

Moisture	3.00 per cent
Volatile combustible	34.00 per cent
Fixed carbon	54.10 per cent
Ash	6.00 per cent
Sulphur	2.90 per cent
	100.00 per cent

To make the necessary experiments a very inexpensive outfit was used, as shown in Fig. 1. The pulverizer was a multiple grinder made by the Hardy Patent Pick Company, Sheffield, England, and consisted essentially of four interior communicating chambers of successively increased diameter in which paddles revolved on arms with correspondingly increased radii. The largest chamber contained a screen through which only the fine dust passed. Coal of the analysis given, previously crushed to nut size, was fed into the hopper by hand, this being the only means of regulating the necessary supply of coal to the furnace. The combustion air blast was connected to the pulverizer just below the hopper to transfer the coal to the pulverizer chamber. The coal was thrown out radially by centrifugal force due to the rapidly-revolving arms and reduced to dust by percussion and attrition and delivered by air current through the screen to the furnace.

This apparatus pulverized coal containing 3 per cent of moisture to a fineness of 78 per cent through a 100 mesh screen, or 91 per cent through a 60 mesh screen. The coal was burned in the furnace with very satisfactory results.

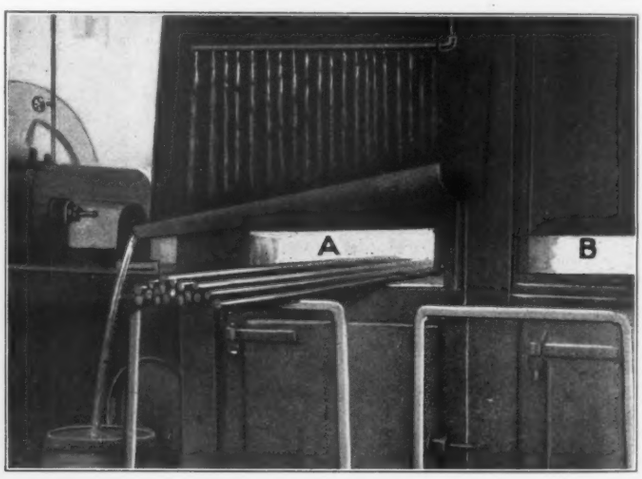


Fig. 2—The Powdered Coal Fire Is Shown at A; B Is a Hard Coal Fire

The furnace used was an ordinary 5 ft. 9 in. by 2 ft. 9 in. anthracite coal furnace used for heating long rods from which rivets and spikes were made. To make the furnace adaptable for burning powdered coal it was necessary to build a 3 ft. combustion chamber on the rear as shown in Fig. 1, and to remove the grate bars and fill the furnace with brick, to make a hearth on which to lay the rods as shown in Fig. 2. This illustration also shows that there is very little difference between the appearance of the powdered coal furnace *A*, when working well, and an anthracite coal fire, *B*.

The table shown below gives the results obtained with this inferior outfit, and also for comparison, the daily average record of another furnace which was equipped with an automatic coal feeder and was operating under the most satisfactory conditions, is given in the last line.

Weight and size of spikes	Total coal burned, lb.	Total furnace hours	Weight coal per hour	Weight of spikes per hour	Coal per 2,000 lb. spikes	Remarks
2,600 lb.—½ in. x 12 in.	840	9 35/60	89.5	272	645	No work during morning
2,600 lb.—½ in. x 12 in.	585	4 35/60	127.5	566	450	Afternoon run only
5,000 lb.—½ in. x 12 in.	1,430	10 30/60	136	476	572	
4,600 lb.—½ in. x 12 in.	1,224	10	122	460	532	
½ in. x 12 in.	.....	..	...	...	580	Daily average of furnace with satisfactory coal feeder

General Machine Tool Efficiency

Discusses Such Influencing Factors as Movement of Material, Grouping, and Machine Replacement

BY GEORGE W. ARMSTRONG
Mechanical Department, Erie Railroad, Meadville, Pa.

There is always a tendency for production cost to increase with an increase in wages. In order to prevent this, as well as to decrease it on account of the stress of competition, a thorough investigation into the economical operation of a plant is necessary. This is commonly designated as its efficiency. Efficiency is a term at present enjoying wide-spread popularity as a panacea for all disorders. In reality, it is only common sense combined with ability to profit by and utilize the results of others' investigations.

The efficient operation of a plant is very largely influenced by its layout as well as its equipment. These are both controlled by the nature of the industry. For purposes of analysis and preliminary considerations of layout, all plants may be divided into three general types:

(1) Those producing one line only; for example, a tube factory.

(2) Those manufacturing articles requiring similar operations to a certain point, and then slightly different, to suit individual requirements, as a furniture factory.

(3) Those doing a diversified or repair business, illustrated by a railroad shop.

It is chiefly with the latter that the writer will deal. This type of plant presents most of the problems and utilizes the principles applying to the first two classes. Owing, however, to the diversified nature of the product, the solution is more difficult and requires frequent compromise to conform to conditions and the principles of ideal working. Efficient operation depends primarily on conformity with:

(1) Movement of material as directly as possible from storeroom to the finished product and without retracing its path; and, when advisable, installation of facilities to minimize handling.

(2) Grouping of machines handling co-related work, making each group complete for the production of its specialty.

(3) Machines so equipped as to afford sufficient latitude in speed and feed to fit conditions of operation; such changes to be capable of being effected with a minimum effort on the part of the operator.

(4) Machines so constructed that the limiting factor for output shall be the tool rather than the machine.

Preliminary Considerations.—A careful and complete study of the situation with respect to output immediately required and future anticipations, and the provision of floor space for material in process of manufacture and its procedure through the shop should precede all other work. The data thus obtained furnishes the basis upon which later the "process diagram" and its accompanying "routing diagram" are worked out. The "process diagram" is a tabulation in detail in proper order of the operations which the material is to undergo, graphically presented in the "routing diagram." These diagrams are the foundation on which the later efficiency of the plant to a large extent depends, as they show the inter-relationships which should exist between operations and processes to accomplish the result with maximum economy.

Movement of Material.—Frequently this study will point to the advisability of establishing more than one storage point for material in order to reduce labor charges for handling, or the introduction of some means of mechanical handling, as crane conveyors, overhead trolley conveyors, industrial trackage, etc. Careful consideration should also be given to the floor space required for materials in transit from one operation to another, and the method of storage. Suitable buggies or conveying buckets for electric cranes can often be introduced for storage of small parts in process of machining, which will materially affect the cost of production of these articles. Long hauls should be avoided whenever possible, as in many cases the labor charges for handling exceed the direct machining costs and every means should be taken to reduce them to a minimum.

Grouping.—Grouping of machines handling co-related work will aid materially in minimizing handling. Machines should be located in sequence of operations as far as permissible, so as to facilitate progress of material. Occasionally, however, a machine may be necessary in two or more groups, and the work in any one of the groups be insufficient to utilize the full capacity of the machine. In considering whether duplication of machines is advisable, in instances of this character, the handling cost must be carefully weighed against the interest and depreciation charges incurred through installing additional machinery for convenience only. The groups must be arranged with re-

TABLE 1—COMPARISON OF LINE SHAFT DRIVE AND INDIVIDUAL MOTOR DRIVE FOR MACHINE TOOLS

	Item	Line Shaft Drive	Individual Motor Drive	Advantage of Individual Motor Drive
1.	Power consumption	Constant friction loss in shafts, belts and motors, power for cutting.	Friction loss (motor and tool only); useful power only while working.	Less power required.
2.	Speed control	No. speeds. No. cone pulleys. No. gear ratios.	No. speeds. No. controller points. No. gear ratios.	More speed possible; time saved in speed adjustments.
3.	Reversing	Clutch and crossed belts.	Reversible controller.	Time saved in reversing.
4.	Adjusting tool and work.....	Stopping at any definite point very difficult.	Can be started in either direction and stopped promptly at any point.	Time saved in setting up and lining up.
5.	Speed adjustment	Large speed increments between pulley steps.	Small speed increments between controller points.	Time saved by obtaining proper cutting speed.
6.	Size of cut.....	Limited by slipping belts. Large belts hard to shift.	Limited by strength of tool and size of motor.	Time saved by taking heavier cuts.
7.	Time to complete job.....	.....	.....	Much less time required as indicated by previous items.
8.	Liability to accidents.....	Slipping or breaking belts, injury of machine tool, cutting tool or prime mover.	Injury to machine tool, cutting tool or motor.	Much less liability to accidents.
9.	Checking economy of operations	Close supervision required; very difficult to locate cause of delay.	Accurate tests possible by means of graphic meter which automatically records delays and rate of cutting.	Delays and remedies easily located without personal supervision.
10.	Flexibility of location.....	Location determined by shafting and changes difficult.	Location determined by sequence of operations; changes readily made.	Greater convenience in handling and increased economy of operation; more compact arrangement possible.

gard not only to uniform routing within themselves, but with due consideration to the inter-relationships, especially where necessary machines are not duplicated. Machines should be preferably located in lanes and so placed as to afford easy communication with the main passageways.

Having developed the "process" and "routing" diagrams, the layout is best accomplished by using cardboard templates of the various machines required. The outline of each template should indicate the overall dimensions of the apparatus, and if greater than the foundation units, the latter should be indicated by dotted lines within the limits of the template. The problem of tool layout now becomes one of "checkers," i. e., so moving and locating machines that they shall embody the principles involved.

MOTOR DRIVE

Intimately connected with the layout is the question of drive. Motor drive more readily commends itself, as shown in Table 1, taken from the A. S. M. E. Transactions for April 12, 1910.

Motor drive facilitates efficient routing, as it permits of flexibility in location of the tool to meet changing conditions. Latitude in speed and feed to fit conditions of operation, provided at the convenience of the operator, will result in more nearly utilizing the machine's capabilities. The elimination wholly, or to a large extent, of line shafting with the accompanying belts,

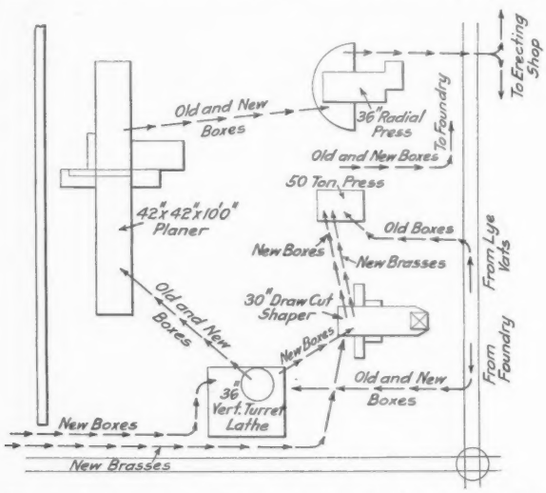


Fig. 1—Arrangement of Tools in the Driving Box Section

besides reducing maintenance costs, will improve the light distribution.

The question of direct or alternating current motors is one largely influenced by local conditions. Where the requirements, however, demand variations in speed, direct current motors are preferable owing to the greater facility in securing such variations. The power required for the machine is best left to the tool builder, unless considerable experience has been had in this line.

REPLACEMENT OF MACHINES

In considering a shop in existence it quite frequently is advisable to replace old machines as well as to re-locate. This requires considerable analysis, further than the determination in reduction of labor costs for machining, as the overhead charge is commonly as great as or greater than the direct charge. By using the method indicated below, combined with the analysis of benefits to which no monetary value can be assigned, a fair indication is secured of the justified policy.

FIXED OR OVERHEAD CHARGE ON NEW MACHINE

(1) Interest on net investment, or A plus B.
A = cost of machine.
B = cost of installation of machine.
(2) Depreciation on machine.
(3) Power costs.
(4) Maintenance of unit complete with its driving accessories.
(5) Machine's percentage of the overhead on building in which it is situated, overhead on power house equipment and of supervision and clerical force.

The yearly overhead charge is the sum of the above items on a yearly basis.

EARNING VALUE OF THE MACHINE

$$\text{Earning value} = O \times (M - N)$$

$$\text{Per cent return on investment} = \frac{[O \times (M - N)] - F}{\text{Net cost installed}} \times 100$$

O = yearly output
M = cost per unit to produce on old machine
N = cost per unit to produce on new machine
F = yearly overhead charge

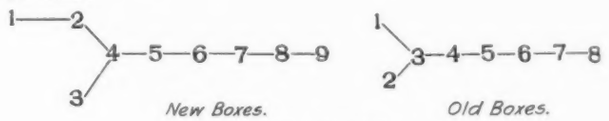
The depreciated life is influenced by ordinary wear and tear on the machine, service conditions, obsolescence due to developments in tool steel and inadequacy from increase in size of parts requiring machining. A fair average for the depreciated life is 10 years, which will adequately take care of the above conditions.

EXAMPLES

As illustrating the method pursued in attacking the problem of efficient layout, the grouping procedure is given in detail for the driving box section (Fig. 1) of a shop turning out 20 locomotives with heavy repairs.

PROCESS DIAGRAM

New Boxes	Old Boxes
1. Face sides. Boring mill.	1. From lye vat to press. Press brass out.
2. Shape crown bearing and cellar fit. Draw cut shaper.	2. Shape brass to fit box. Draw cut shaper.
3. Shape brass to fit box. Draw cut shaper.	3. Press brass in box.
4. Press brass in box.	4. Pour liner.
5. Pour liner.	5. Bore to fit axle. Face hub liner. Boring mill.
6. Bore to fit axle. Face liner. Boring mill.	6. True shoe and wedge fit. Planer.
7. Plane shoe and wedge fit. Planer.	7. Drill oil holes.
8. Drill oil holes, cellar pin holes, etc. Radial drill.	8. Fit cellar.
9. Fit cellar.	



Routing Diagram

TIME STUDY BASED ON 20 HEAVY REPAIRS PER MONTH

Machine	Operation	Number pieces and total time
Planer	Plane shoe and wedge fit, new boxes	
42 in. x 42 in. x 10 ft. Reversing motor drive	20 x 8 x 10%	16 per month
	Ave. time per box, 1¾ hrs.	3½ days' work
	Plane shoe and wedge fit, old boxes	
	20 x 8 x 90%	144 per month
	Ave. time per box, 1¼ hrs.	22½ days' work
	Total 3½ + 22½	26 days' work
	Shape crown bearing and cellar fit, new boxes	
Draw cut shaper Morton 30 in.	20 x 8 x 10%	16 per month
	Ave. time per box, 1¼ hrs.	2½ days' work
	Shape crown brasses, new and old boxes	
	20 x 8 x 75%	120 per month
	Ave. time per box, ¾ hr.	11¼ days' work
	Fit cellars to boxes	
	20 x 8 x 20%	32 per month
	Ave. time per box, ½ hr.	2 days' work
	Total 2½ + 11¼ + 2	15¾ days' work
	Face new steel boxes	
	20 x 8 x 10%	16 per month
	Ave. time per box, 1 hr.	2 days' work
Boring mill	Bore brass to fit axle, old and new boxes	
36 in. Vertical Turret lathe (Bullard)	20 x 8 x 75%	120 per month
	Ave. time per box, ⅔ hr.	10 days' work
	Face hub liner, old and new boxes	
	20 x 8 x 100%	160 per month
	Ave. time per box, ½ hr.	10 days' work
	Total time, 10 + 2 + 10	22 days' work
	Drill press	
3 ft. Radial Drill	Drill new boxes	
	20 x 8 x 10%	16 per month
	Ave. time per box, 2½ hrs.	5 days' work
	Drill old boxes	
	20 x 8 x 75%	120 per month
	Ave. time per box, ½ hr.	7½ days' work
	Total time, 5 + 7½	12½ days' work

The time study is very necessary in connection with the process and routing diagrams in ascertaining whether it is necessary to so place machines that they serve more than one group in order to obtain maximum production. At best, the actual time the machine is in operation is but 50 per cent of the total working time. As the overhead charge per working hour is piece-work, probably no material decrease in cost of shop operation could be predicted. Piece-work being a 100 per cent premium system, no decrease in cost is effected as output increases. Nevertheless, given efficient working conditions, the output per forge or machine being increased, the shop output is thus favorably increased, and the force could be reduced, allow-

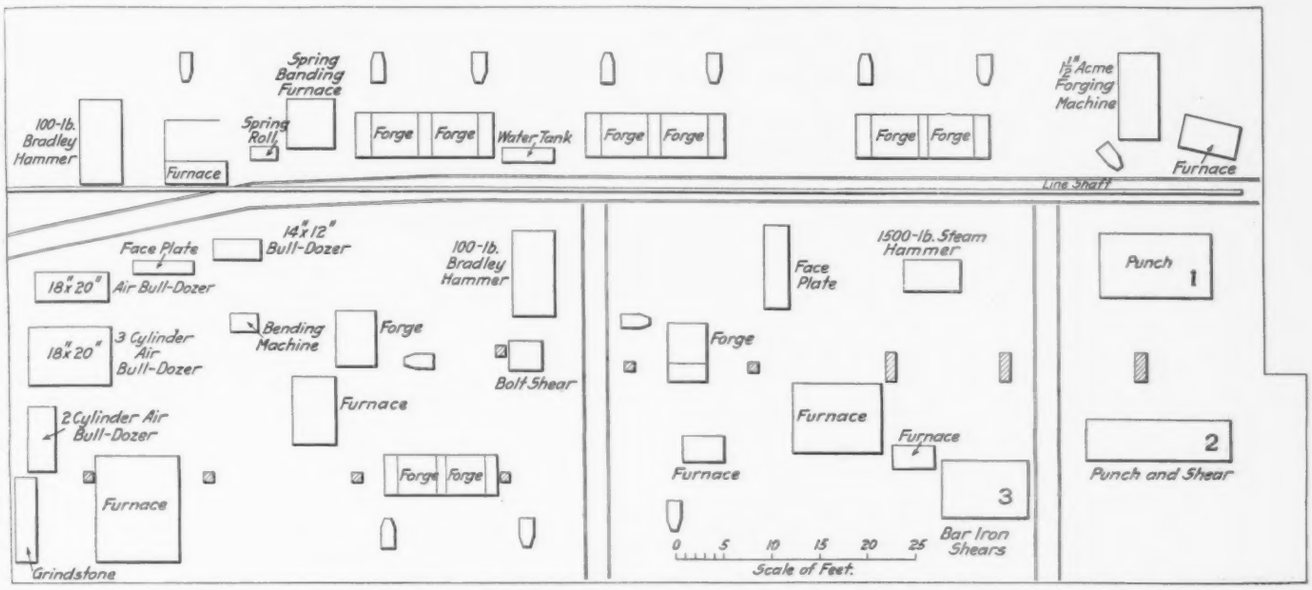


Fig. 2—Layout of Smith Shop Before Tools Were Re-located

100 per cent to 200 per cent of the labor charge, it is of the utmost importance to utilize a machine tool to the greatest possible extent.

In the case considered above, the problem to be met was in connection with a new layout. It frequently is advantageous to rearrange an old layout to obtain more efficient working conditions. Such is the case in the study of the blacksmith shop

ing higher earnings to employees retained, thereby tending to less dissatisfaction with working conditions.

Introducing more efficient working conditions and securing greater output with the same original investment and supervision reduces the overhead charge upon that output. Thus, labor charges remaining fixed, the total cost of output is reduced. Securing increased output also facilitates other shop ac-

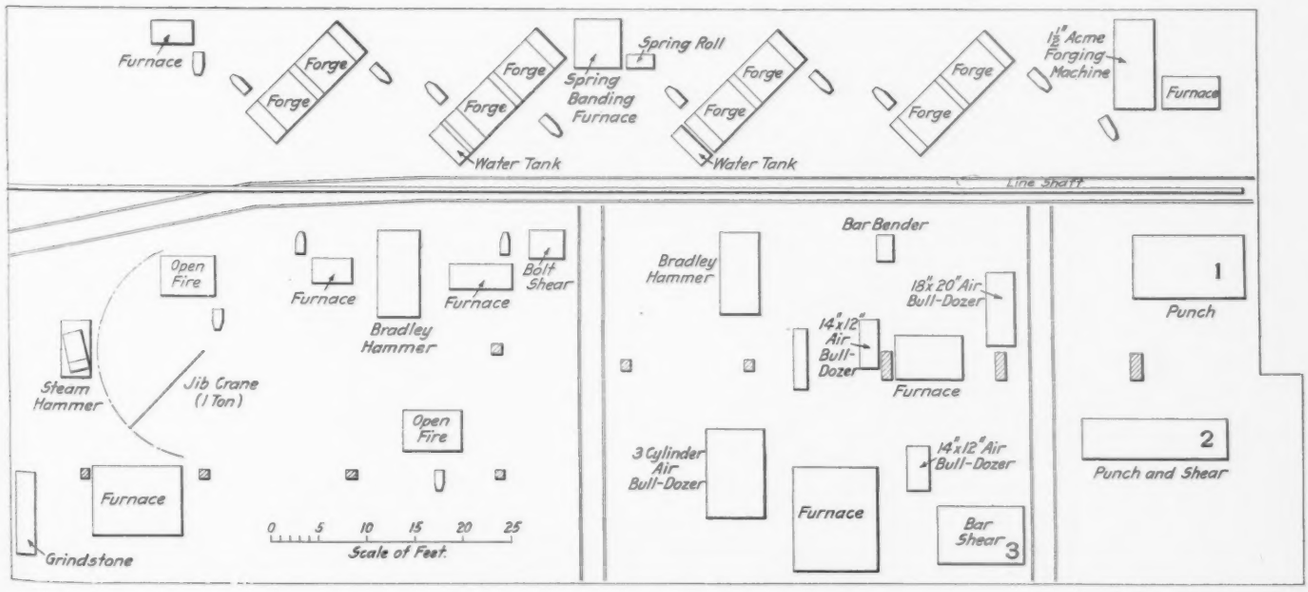


Fig. 3—Plan of Smith Shop After the Tools Had Been Rearranged

(Figs. 2 and 3) presenting conditions existing on many of our railroads today.

Under the old arrangement, the shop is congested and much unnecessary movement and handling of material is required which can be eliminated by a proper arrangement of equipment. Should the shop operate at a high percentage (75 per cent) of

tivities by decreasing the delays for material and therefore tends to increase total shop output.

Criticisms in detail of the layout assumed follow, with recommendations from which are evolved the proposed layout.

Forging Machine and Furnace.—Congestion at this point is an important factor in reducing the output of the machine. Too

much space is wasted by its present location, and this is reduced to a minimum by relocation and allows much more space for raw and finished material.

Forges.—These are not located so as to permit of the greatest available space and further are not all grouped together. By setting at an angle of 45 deg., more space is secured; in fact, more forges could be placed in the allotted space than at present, without undue crowding. All forges also present a clear view to the foreman passing down the aisle and thus render supervision more efficient.

Bradley Hammers.—These are not at present located so as to be conveniently accessible from all points of the shop. While one hammer is practically in constant use by one man, still it should be more centrally located. Then by concentrating the operations not requiring much hammer work at adjacent forges, it is free for the use of this one man while still conveniently available for the occasional job.

Steam Hammer.—This is at present occupying space which should be utilized by machinery for doing work requiring punching and shearing. This hammer is used almost exclusively by the steam hammer gang, only an open fire having work to perform which could be worked under it. This can therefore be more efficiently placed at the end of the shop nearest the machine shop and the open fire located so as also to be served by the jib crane in case of necessity.

Bulldozers.—The present location of the bulldozers is conducive to inefficiency. All material worked on them is first sheared at the other end of the shop and, after being formed to proper shape, is quite frequently returned again for punching. By relocating as shown, a minimum of movement is secured which should materially reduce output cost.

Punch and Shears.—Punch 1 should be moved back as shown so as not to be rendered inoperative as at present when long material, as channels or angles, is punched on 2. Shear 3 should be moved nearer the door so as not to interfere with punching wide material on 2, and a small opening with a door should be provided in the wall in line with the shear blade. Punch and shear 2 has not been relocated owing to the difficulty of securing sufficient operating room. It is, however, recommended that if much underframe work is to be done, a covered and enclosed vestibule be provided of sufficient length so that the shop does not have to be open and men stand exposed to the elements. A trolley crane should be provided so as to efficiently handle work at the punch. A vestibule should also be provided so that large sheets can be handled under the shears without the discomforts mentioned above. While these may seem needless details, still they are essential for efficient working.

Minor Details.—The open fire at present located next to the steam hammer should be relocated as shown. This fire is an extra one and can be well utilized for brake beam work now performed just outside the building, giving this space for storage room. For handling light material, small buggies are recommended. Their use will reduce labor handling operations and therefore costs, economize space and permit of quick delivery of raw and finished products.

It will be apparent that the congestion has been greatly relieved by the new layout. Considerable difficulty is also experienced because of the posts supporting the roof which is of wooden construction. This difficulty has been eliminated as far as possible by proper grouping.

WIRELESS ON THE GREAT LAKES.—According to the Department of Commerce, the disastrous storm of last November on the Great Lakes furnished a signal illustration of the necessity of equipping lake vessels with wireless telegraphy. All vessels so equipped received warning of the storm and sought shelter, while 19 American vessels without wireless were lost. About 50 vessels are now preparing to add wireless telegraph apparatus to their equipment.—*Scientific American.*

AIR VALVE GAGES

BY J. A. JESSON
Air Brake Foreman, Louisville & Nashville, Corbin, Ky.

The engravings illustrate gages for use in fitting valves in locomotive air pumps. In order to be prepared for any condition arising, a number of valves are kept ready with their bosses faced down in a lathe, beginning at standard, when no wear exists, and ranging in steps of 1/32 in. to fill in when wear and reaming of seats have taken place. The values of different heights are stamped 0 for standard and 1, 2, 3, according to variation from standard. After the proper height is obtained it is only necessary to select the proper valve by number.

Fig. 1 shows a combined height and depth gage *A*, in use over

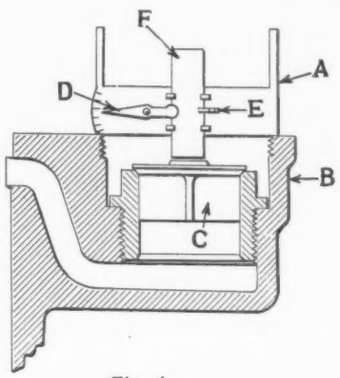


Fig. 1

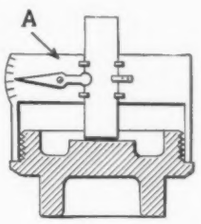


Fig. 2

the upper pump valve *C*, and resting on the body *B*. The slide *F* is held by pins and a flat spring *E*. A semi-circular piece is removed from one side of the slide. The indicator *D* has a circular head that fits neatly in this semi-circular space, and the indicator is held in position by a loose rivet. The graduations are determined by the length of the indicator. The one used by the writer travels ⅛ in. for a 1/32 in. adjustment of the slide, which renders the reading easy.

Fig. 2 shows the gage in position on the valve cap, and Fig.

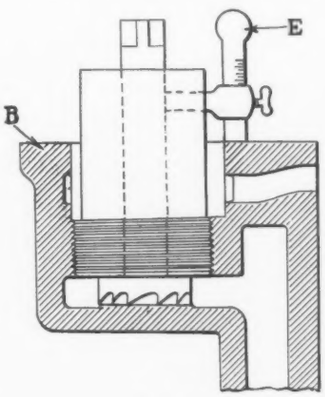


Fig. 3

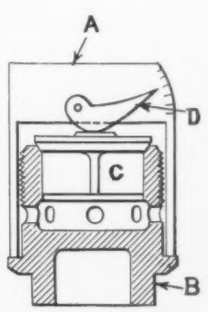


Fig. 4

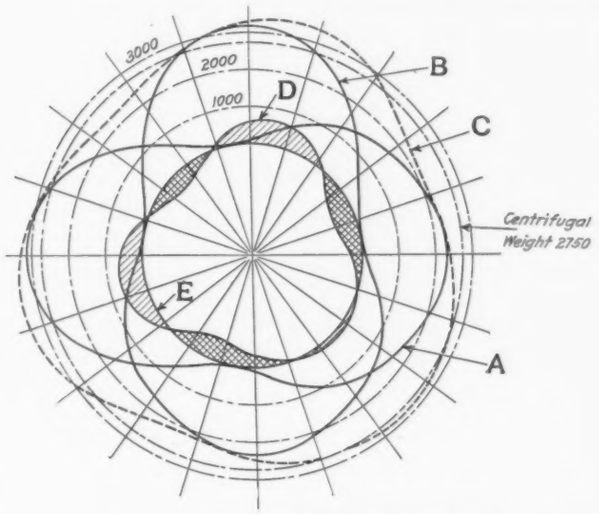
3 shows a combined reamer and gage, as it is occasionally necessary to square up the valve stop in the body. A gage is extended from the reamer pilot with graduations on its slide, a set screw being provided for holding. As the reamer moves in, the slide backs up correspondingly. Fig. 4 shows a height gage for the valve in a cage; the indicator moves on a loose rivet. This construction permits the use of a large scale in the graduation.

COAL IN RUSSIA.—The Russian Geological Committee estimates the coal deposits of Russia and the Caucasus to contain from 70,000,000,000 to 75,000,000,000 tons.

NEW DEVICES

ANGLE COMPOUND POWER DRIVEN AIR COMPRESSOR

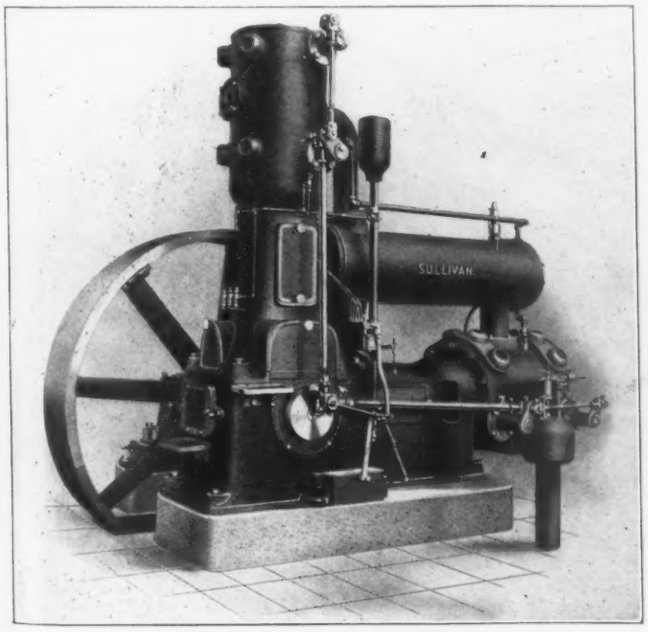
The accompanying illustrations show a type of air compressor recently placed on the market by the Sullivan Machinery Company, Chicago, Ill. It has been the purpose of this company to design a compressor to operate at fairly high speed, and have it simple in construction and occupy as little floor space as possible. As will be noted from the illustrations the low pressure cylinder is placed horizontally and the high pressure cylinder vertically on the frame. This arrangement permits of small floor space, as well as making it possible to more accurately balance the reciprocating parts of the compressor. Both the high and low pressure pistons are actuated by a single crank, and both sets of valve gear by a single eccentric pin. These machines are built in capacities ranging from 445 cu. ft. of free air per minute, to 1,094 cu. ft., the speed ranging from 250 to 215 r. p. m., respectively. The large size compressor has cylinders 12 in. by 20 in. by 14 in., and occupies a floor space of 11 ft. 4½ in. by 7 ft. 10½ in., and is 9 ft. 9 in. high. In cases where it is desirable to have more than this capacity, double units of these compressors have been used.



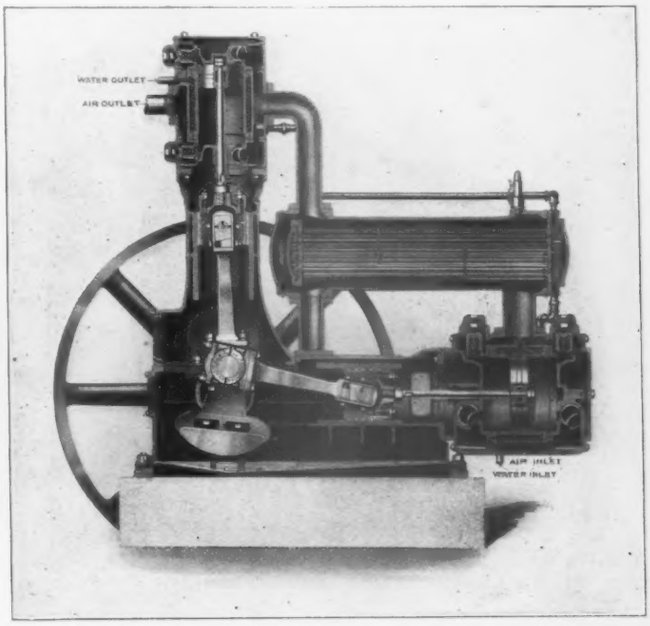
Inertia Diagram of Reciprocating Parts

One of the most interesting features of the design is the balancing of the reciprocating parts. In this machine the disturbing influences of the horizontal and vertical members tend to offset or neutralize each other. The inertia diagram shown herewith shows how these forces are balanced. Curve *A* represents the forces in the horizontal unit and curve *B* those in the vertical unit. Curve *C* presents the sum of the upper two curves, and approximates a circle, showing that the disturbance produced is nearly uniform throughout the revolution. By applying a revolving weight to balance these centrifugal forces, the resultant unbalanced effect is shown by curve *D*, which reduces the unbalanced forces from approximately 3,000 lb. to 500 or 700 lb. It is claimed that the machine may easily run at the speed mentioned without any noticeable vibration, and on this account it has not been found necessary to have a massive foundation. By absorbing the inertia loads due to the reciprocating parts in the shaft itself, a more uniform distribution of the working pressures has been obtained in the shaft boxes, and on this account they should require less adjustment, the wear being more evenly distributed over the whole surface of the bearings.

The crank shaft is supported in large bearings located on either side of the crank pin and close to it, the load imposed by both cylinders being borne equally by these bearings, without any tendency to rock or spring the shaft or the main frame. The latter is of the heavy duty Tangye type and is strongly ribbed. The guides for the low pressure crosshead and the jaws for the crank shaft boxes form part of the frame casting. The bottom of the frame is solid, forming a reservoir for the oil, but there are openings in the sides for inspecting the



Sullivan Angle Compound Air Compressor



Sectional Elevation of the Compressor

crosshead. The main bearings are made of cast iron and have four parts. They are lined with babbitt and have a set screw adjustment. They are so designed that all four parts may be removed without removing the main shaft.

Both the low and high pressure cylinders are made with separate liners forced into the frame castings, the spaces between the liners and cylinder castings forming the water jackets. The air inlet valves are of the Corliss type, being made of cast iron, and are cylindrical in shape. They may be removed by removing the back bonnets and withdrawing the valves by means of screw handles, without disturbing the cylinder heads or the valve gear. The air discharge valves are of the poppet type, internally guided on cast iron plugs, and are held to the seats by light steel springs. They seat in bronze cages and are easily removed by unscrewing the valve plugs. The intercooler is a cylindrical cast iron shell, consisting of a nest of aluminum tubes, which may be easily removed. The crank shaft bearings, crank and crosshead pins and crosshead guides of both the high and low pressure members, are supplied with stream oil lubrication.

These machines may be driven by either a belt or a direct connected motor. When a motor is used it is necessary to use a flywheel.

STREET TYPE C LOCOMOTIVE STOKER

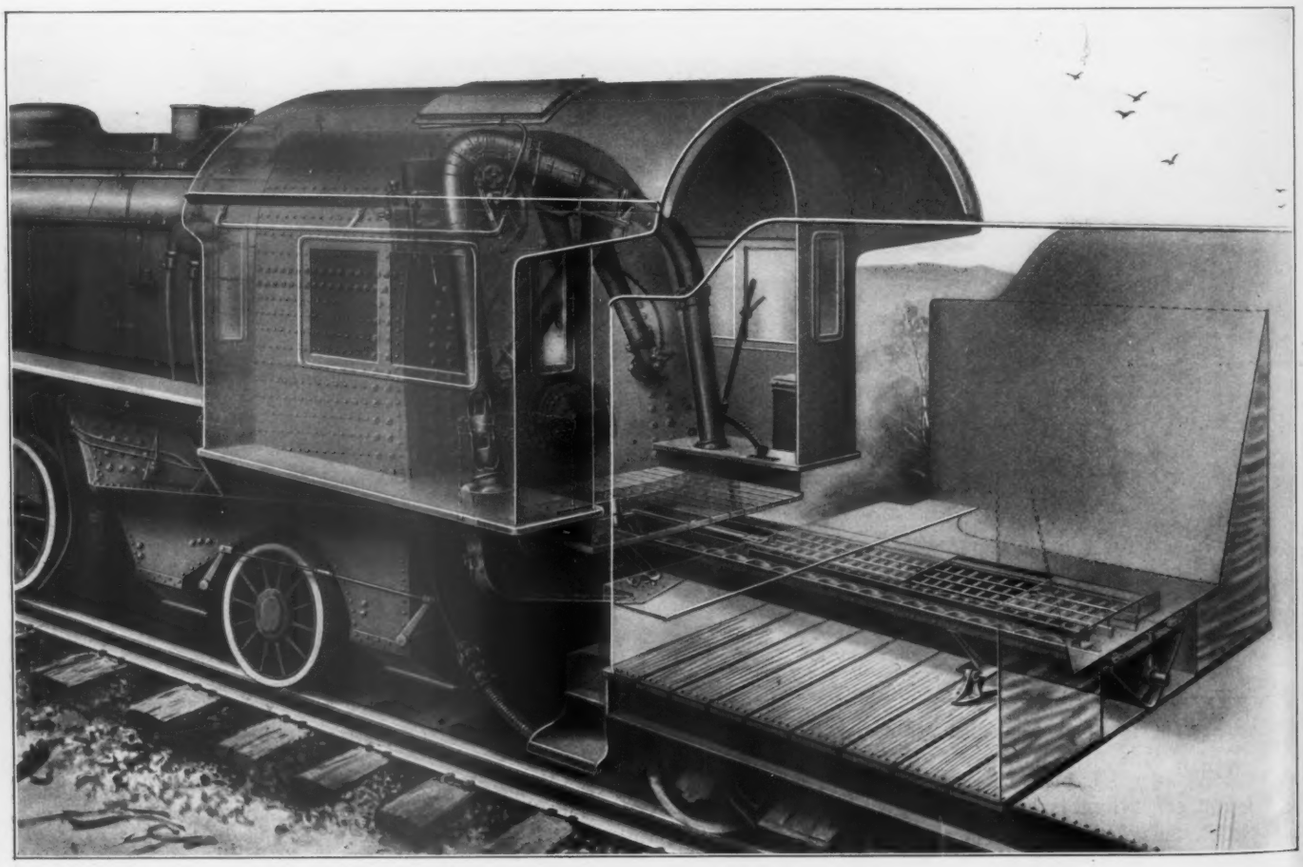
The accompanying illustration shows the latest form of Street locomotive stoker, designated as Type C, as applied to a locomotive. This stoker retains the general features of the Type B machine, which consists of a screen in the floor of the tank, through which the coal passes to a screw conveyor, which carries it from the tender to the locomotive. On the locomotive, it is deposited in a hopper from which it is, by means of an endless chain elevator, carried to a discharge pipe above the fire door. The discharge pipe embodies a screen which removes the dust and small particles, and deposits them through a center distributor, across the back end of the grate under the fire door. The larger particles pass over the screen and are divided between two side distributors which distribute them over the remaining section of the grate.

The Type C machine differs from the Type B in having a variable speed engine for driving the elevator, and a friction clutch for making connection between the engine and the elevator. The variable speed engine was introduced for the purpose of giving the fireman an absolute control over the quantity of coal to be conveyed to the firebox. This engine has seven different speeds and is controlled by a small lever on the front of the crank case. By setting this lever in a given notch, a fixed feed of coal is obtained, and is maintained regardless of the load on the engine. This enables the fireman to duplicate results in his firing on different locomotives and at different times on the same locomotive.

The friction clutch enables the fireman to start and stop the feed of coal instantly at any time. The elevator engine is allowed to run continuously, and by throwing in the clutch lever, the elevator can be started and the feed of coal to the firebox begins at once, as under normal conditions the elevator buckets are full of coal. Throwing the clutch lever out stops the feed of coal.

These two improvements in the Street stoker have been in the course of development for the past two or three years, and all the machines now being built embody them. It is believed by the manufacturers that they give the fireman absolute and accurate control of the fire, and the results of service show that they enable him to make a considerable saving in the coal consumed.

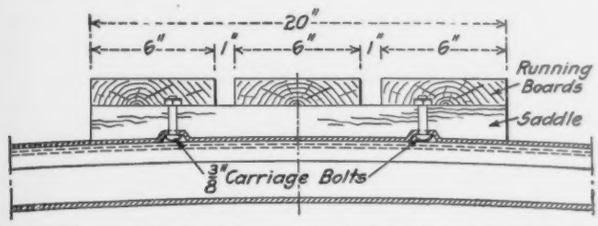
Over 100 of these new type machines are now on order, or being applied to locomotives by the Locomotive Stoker Company, Schenectady, New York, which company controls the Street stoker.



Street Type C Stoker Applied to a Locomotive

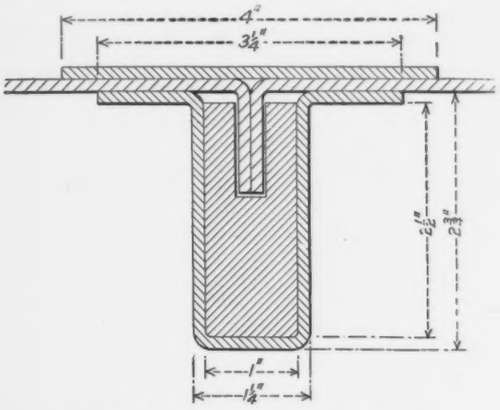
CHRISTY STEEL FREIGHT CAR ROOF

A style of steel roof which a study of its design would indicate to be of ample strength and waterproof in every detail, has recently been placed on the market by the American Car Roof Company, Marquette Building, Chicago, Ill.



Section Through Carline Showing the Application of Running Board Saddle

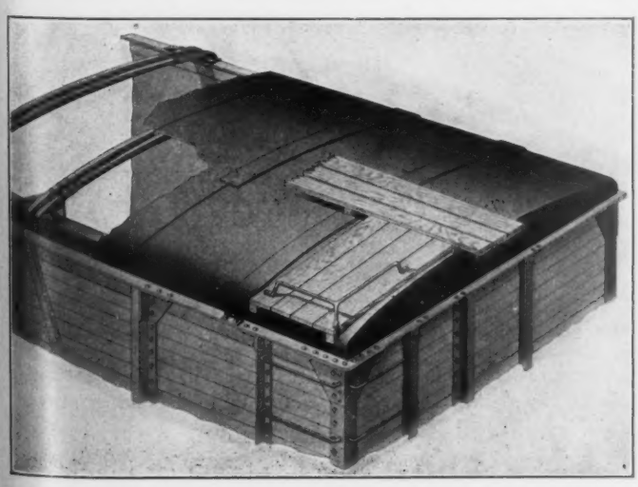
It is made up entirely of pressed steel shapes, there being only five different shapes throughout the construction. The designers have so arranged their plans that this roof may be applied to any type of car with but few modifications. The photograph shows its application to the steel frame box



Longitudinal Section at Center of Car

car. Being made up of comparatively small units it should be an easy matter to renew any sheets or carlines that may become damaged.

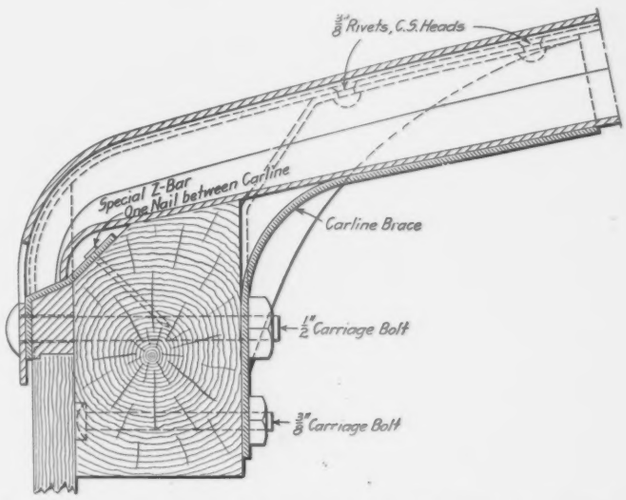
The five different pressed steel shapes that are used are



Christy Steel Roof Applied to a Steel Frame Box Car

the roof sheets, the carlines, the carline braces, the cap strips and a special Z-bar extending along the top of the car sheathing and the side plate. The roof sheets are rolled steel, extend over the full width of the car and are flanged from 30 in. No. 14 gage steel. They have a pitch of 6½ in. in 4 ft. 7⅞ in. and are formed to a smaller radius at the ends to fit over the sides of the car. The roof sheet flange is ¾ in. deep and rests in the carline, which is in the form of a flanged U-section.

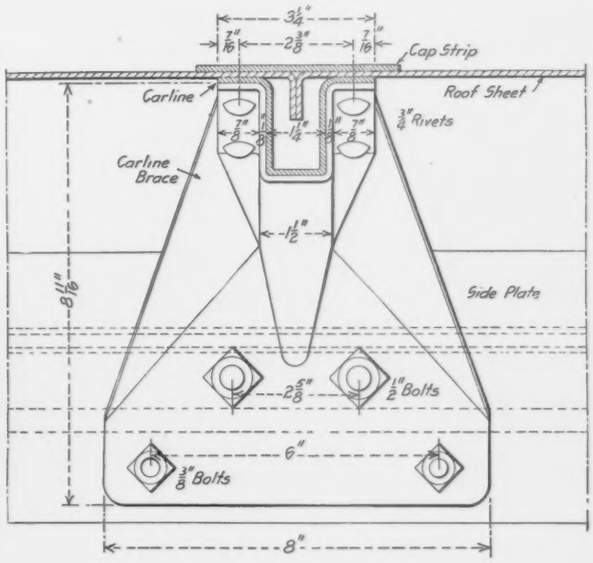
The carlines are spaced 27¼ in. between centers for a 40 ft. car and are shaped to conform to the pitch of the roof.



Section Through Carline at the Side Plate on a Wooden Frame Car

The method of supporting them at the side plates is clearly shown in the illustrations. The carline braces are riveted to the carline flanges by four countersunk rivets and are bolted to the side plate by two ½ in. and two ⅜ in. carriage bolts. A cast iron block 2 in. long placed in the carlines at the center of the car, is cut out to receive the flanges of the roof sheets and serves to keep them in alinement.

The cap strips are 4 in. wide by ⅛ in. thick. They hold



Section Near Carline Brace

the roof sheets in place, these sheets not being held by any other means. These strips extend from one side of the car to the other, extending over the joints of the sheets as shown, and are attached to the side plates by two ½ in. carriage bolts. The strips are deflected at the top of the car to receive the bolts for the running board saddle. The special Z-bar is placed at the side plate to give the necessary stiff-

ness to the side of the roof, and also performs a function in the waterproof features of the car.

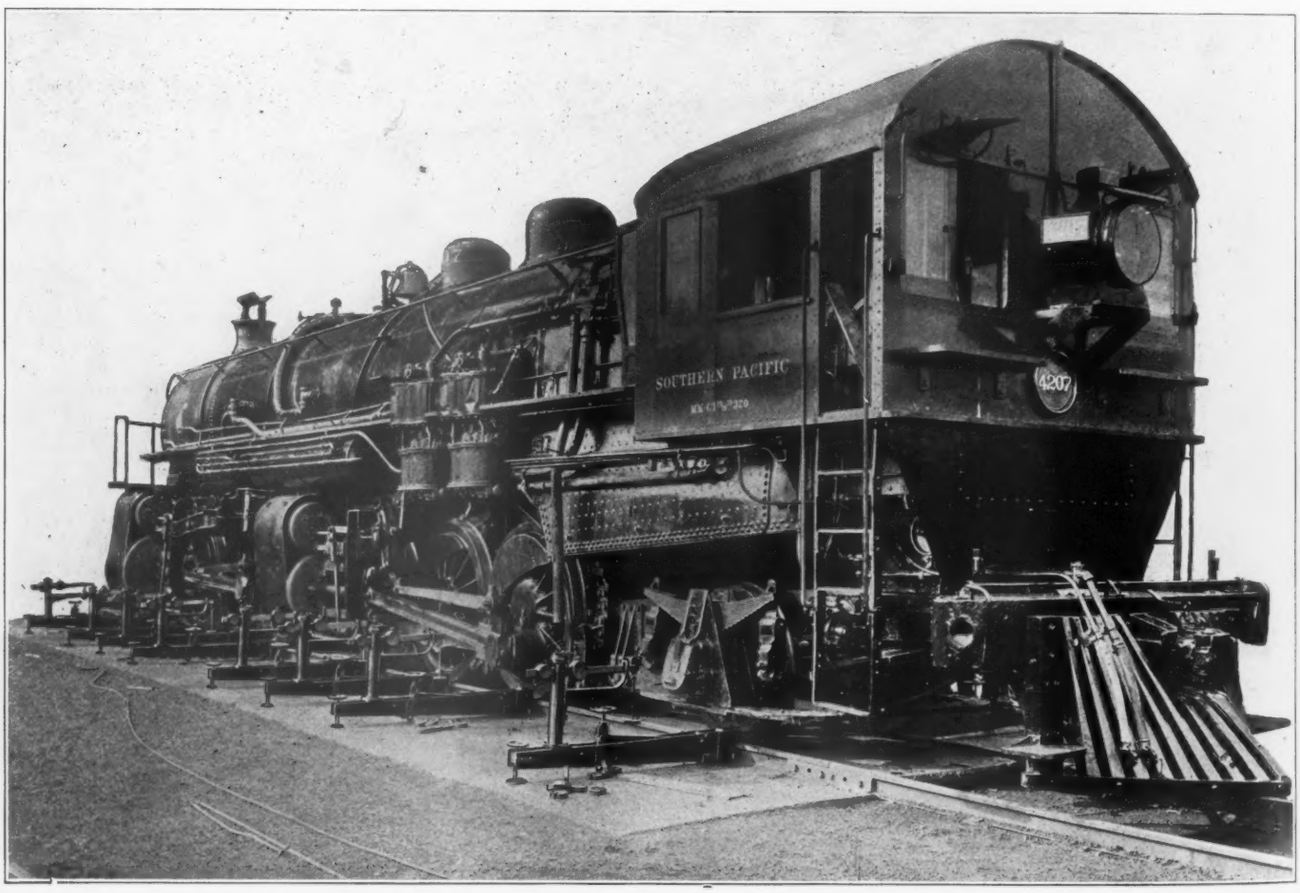
As there are no holes made in the roof sheets, the only way for water to work its way through into the car is around the edges of these sheets. This has been taken care of by having the sides of the sheets drain directly into the trough of the carline, which, on account of its pitch, will drain any water that may collect to the sides of the car and allow it to escape through a 1¼ in. by 1 in. hole in the cap strips provided for that purpose. The Z-bars at the sides of the car prevent water working up by the side plate.

This roof eliminates the use of purlins or a ridge pole, which, it is claimed, are not necessary with this construction. The roof was invented by Henry A. Christy, the inventor of the Christy grain door.

STANDARD LOCOMOTIVE SCALE

A locomotive scale which permits of obtaining the individual wheel loads of a locomotive has recently been placed on the market by the Standard Scale & Supply Company, Pittsburgh, Pa. Separate scale beams are used for each wheel, and are applied as shown in the illustration. One of the chief advantages of the use of this scale is that no expensive foundation is required, and the locomotive may be weighed at any point on the line, as well as in shops. It is, however, essential that the roadbed be solid, and it is preferable to have a concrete base filling between the ties up to the base of the rail. By this method it is possible to determine whether any one pair of drivers has an excessive weight on the rail, and the scale can be used for checking up the distribution of the weight of the locomotive throughout the wheels. The scale beams are of simple construction, the main lever projecting beyond the frame of the scale a sufficient distance to engage the locomotive wheel, the frame itself bearing on the base of the rail during the weighing.

The scale levers are of forged steel, and the weighing beam is graduated from 5,000 to 10,000 lb. in 50-lb. divisions. Weights are piled on the end of the beam for additional capacity. Each scale weighs approximately 450 lb., and is constructed for use on 80, 90 or 100 lb. rails. In weighing a locomotive the extreme end of the main lever is placed in its lowest position by operating the hand wheel under the weighing lever, the frame is placed upon the rail and leveled by the other hand wheel, to make the column plumb. To lift the locomotive wheel, the hand wheel under the beam is turned down until the weighing beam is balanced with the poise at the 5,000-lb. mark. The hand wheel develops 5,000 lb. pressure against the locomotive wheel in balancing the scale, so that loads less than 5,000 lb. cannot be read. When all of the wheels are raised a metal strip ¼ in. thick should be passed between the top of the rail and the tread of the wheel, and a strip ⅛ in. thick between the gage of the rail and the flange of the wheel, in order to eliminate the possibility of friction preventing the free movement of the weighing beam.



Standard Scales In Use for Determining Locomotive Wheel Loads

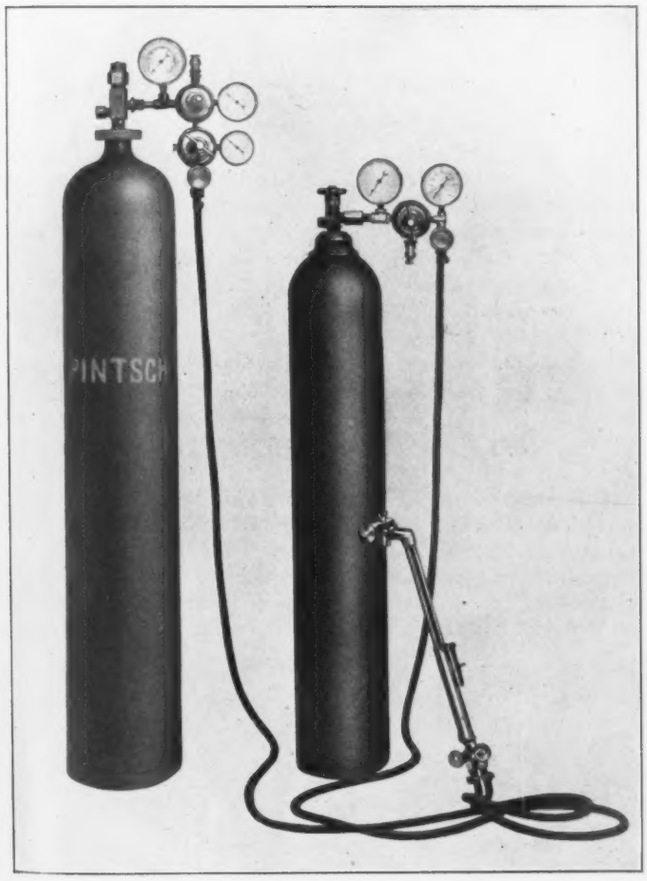
These scales are now being used by the Baldwin Locomotive Works, the Atchison, Topeka & Santa Fe, and other railways.

SHIPPING ON THE LAKE OF CONSTANCE.—The Austrian fleet on the Lake of Constance consists of six steamers of the value of about $450,000. The importance of this branch of Austrian shipping is decreasing every year, and its bad financial results are ascribed to the recently introduced measures for the social welfare of employees and to excessive taxation.

METAL CUTTING AND WELDING WITH OXYGEN AND PINTSCH GAS

Flame cutting and flame welding processes have helped to solve many problems that have been created by the increased use of metal construction in railway equipment.

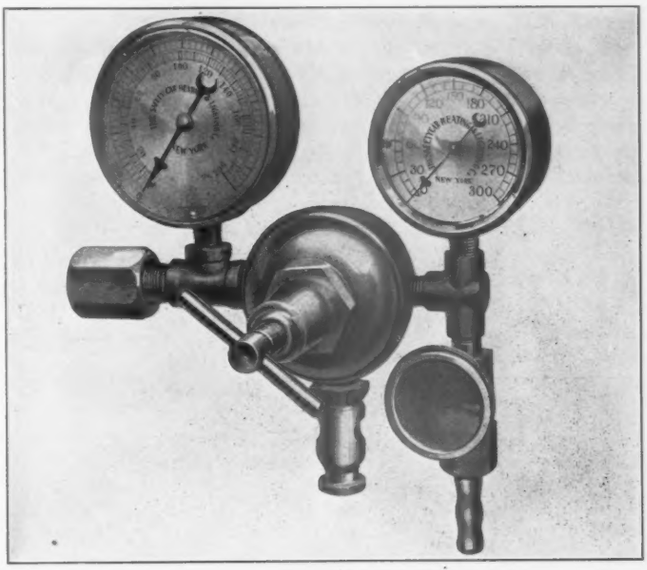
After much careful research and development work, a metal cutting and welding torch has been developed by the Safety Car Heating & Lighting Company, 2 Rector street, New York. The possibilities in the use of Pintsch gas for high temperature flame work, and the availability of this gas in the railway field acteristic stability, or resistance to pre-ignition, is well suited were recognized as of value in the solution of the problem. Pintsch gas, on account of its high calorific value and char- for high temperature flame work. The numerous Pintsch plants or supply stations, located throughout the United States, Canada and Mexico, supplying gas to the railroads for car lighting



Oxy-Pintsch Metal Cutting Equipment

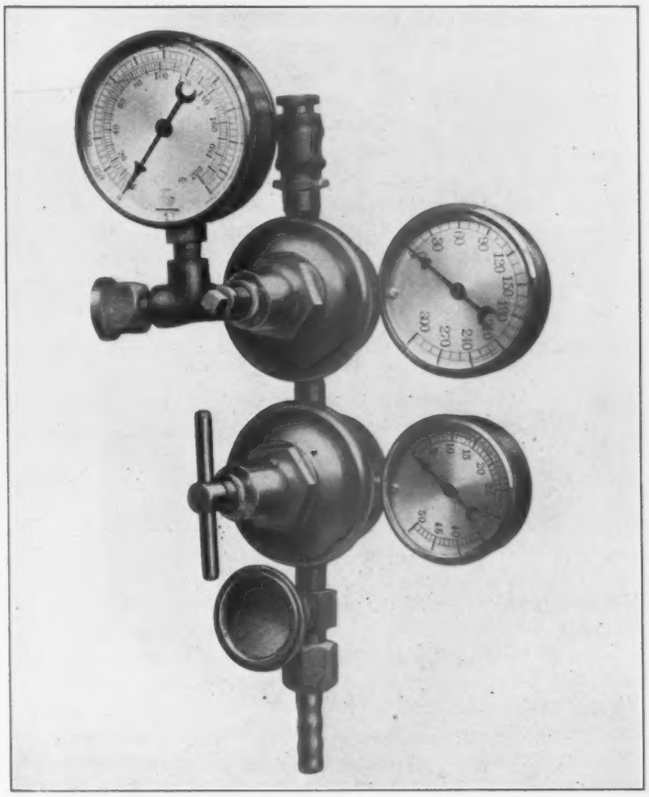
purposes, can deliver gas to the railway shops, or other points where needed, at a minimum cost and with minimum delay. A large number of the Pintsch supply stations are equipped to furnish Pintsch gas at 100 atmospheres pressure, so that the necessary quantity of fuel for cutting or welding can be furnished in the most compact form, which is another factor aiding in the low cost of metal cutting by this equipment.

The Oxy-Pintsch cutting and welding equipment is simple and compact. Pintsch gas, similarly to the oxygen used, can be supplied directly to the torch from either low pressure or high pressure flasks. The gas can also be distributed through the pipe lines operated by the Safety Car Heating & Lighting Company, to the points of consumption where practical. No expert knowledge is needed to properly handle the equipment. One of the illustrations shows the equipment complete, consisting of a high pressure Pintsch gas flask, an oxygen flask, pressure regulators, hose to convey the Pintsch gas and oxygen to the cutting or welding torch, and the Oxy-Pintsch cutting torch. The gas pressure is in all cases reduced to the proper cutting or welding pressure by means of suitable regulators.



Oxygen Regulator

Pintsch gas is supplied in holders or flasks at either 12 atmospheres or 100 atmospheres pressure. The pressure reduction from the high pressure flask is made in two steps, insuring a uniform discharge pressure. The first pressure re-



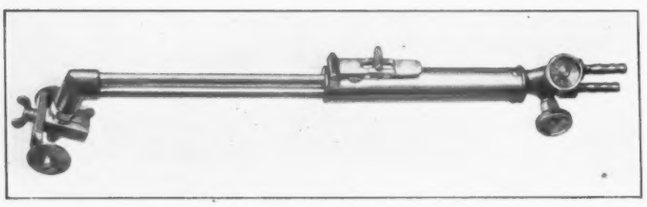
High Pressure Pintsch Gas Regulator

duction is made to 14 atmospheres, the regulator for this reduction being equipped with a safety valve which releases the pressure when 20 atmospheres is exceeded. The gas pressure

required at the torch for cutting or welding does not exceed 25 lb. per sq. in., which is obtained by means of the second pressure reduction. When Pintsch gas is taken from holders or pipe lines at pressures up to 14 atmospheres, an automatic low pressure regulator is used. This regulator is designed to maintain any desired uniform pressure reduction.

The oxygen is delivered at a uniform working pressure up to 150 lb. per sq. in. An automatic oxygen pressure regulator is employed, and is designed for the use of either high pressure or low pressure oxygen; it is equipped with a safety valve which releases when a pressure of 300 lb. per sq. in. is exceeded.

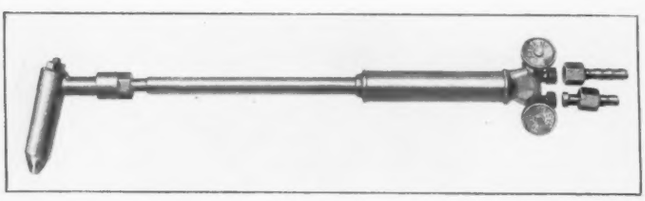
One of the engravings shows the Oxy-Pintsch cutting torch, model A. There are but two hose connections, one for Pintsch gas and one for oxygen. The Pintsch gas and oxygen for the heating flame are controlled by two lever valves, making a quick and accurate adjustment possible. The oxygen for the cutting is controlled by a third lever valve which can be readily opened or closed, as required, by a slight pressure of the



Model A Cutting Torch with Guide

thumb. The cutting tip of this torch is of annular form, with the oxygen cutting jet located centrally. Since the cutting jet is surrounded by the heating flame, it performs its proper function irrespective of the direction in which the cutting tip is advanced. This cutting tip also incorporates a novel design which causes the heating flame to develop inside of the tip. The heating flame, thus protected from the entrained air, is positive and effective in action, greatly facilitating adjustment for working conditions. The illustration shows the cutting torch equipped with a guide, the use of which is recommended wherever permissible as an aid to accurate cutting.

The model B Oxy-Pintsch combination cutting and welding torch is fitted with cutting and welding attachments, and has all the advantages outlined in connection with model A for metal cutting. The welding device illustrated can be used satisfactorily for repair work to castings or for welding steel or wrought iron of moderate thickness. In order to produce a

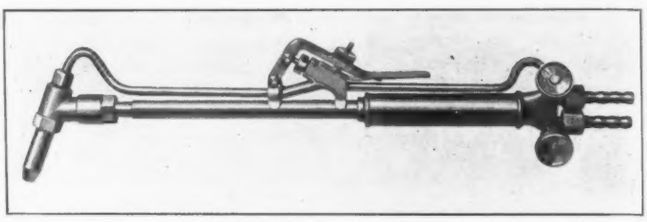


Model B Welding Torch

high temperature non-oxidizing flame, advantage is taken in this design of the principle of pre-heating the Oxy-Pintsch gas mixture. This is accomplished by means of a pre-heater, incorporated in the tip of the torch, performing its function by internal combustion. The gaseous mixture is pre-heated in this manner to a high temperature, to which is added the temperature of combustion, resulting in an effective high temperature welding flame.

The cost of cutting metal with the Oxy-Pintsch cutting equipment as compared with the cost of cutting by other methods demonstrates the advantage of this equipment in many branches of railway work. The saving effected is more fully appreciated by figures taken from actual service. In cutting with this equipment through 25 ft. of 18 in. channel used in car construction, where the average thickness of the metal was 15/32 in., and the length of the cuts varied from 7/16 to 1 in., the cost per lineal foot of cut was $.034, or a total cost of $.862. The actual time consumed, including shifting the beam, was 33 minutes. The oxygen consumed cost $.623, the Pintsch gas cost $.018, and the labor $.22.

The actual cost for similar work with the old process of chipping and drilling for the same total length of cuts was $4.66. The cost of cutting with the Oxy-Pintsch equipment was thus less than one-fifth the cost of cutting by drilling and chipping.



Model B Cutting Torch

The following table serves to illustrate what has been accomplished in cutting steel with the Oxy-Pintsch cutting equipment. The results given in this table were obtained under service conditions by means of hand cutting with the model A torch without a guide. Considerably better economy can be obtained where mechanical guiding is permissible:

Tip number	Thickness of steel	Pressure of oxygen, lb. per sq. inch	Pressure of gas, lb. per sq. inch	Cu. ft. of oxygen per foot of cut	Cu. ft. of gas per foot of cut	Time in minutes per foot of cut
1	¼ in.	15	20	.53	.15	.70
1	½ in.	25	20	1.15	.20	.85
1	1 in.	35	20	1.80	.30	1.25
2	2 in.	40	20	4.10	.40	1.65

SELLERS COUPLING NUT

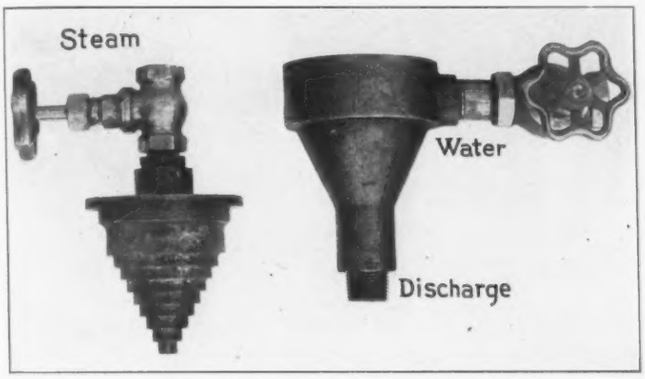
An improved form of coupling nut for injector and valve connections is being introduced by William Sellers & Co., Incorporated, Philadelphia, Pa. This nut, it is claimed, eliminates the weak points and retains the advantages of the present forms of brass nut. It consists of a threaded ring of hard bronze provided with the usual internal collar to hold the brazing ring

Sellers Coupling Nut for Injector Connections

or threaded union of the pipes to the injector or valve branch. Around this ring, dovetailed and keyed to it, is a heavy steel band with eight slots (two more than is usual), for the spanner wrench, permitting the wrench to be applied in any position of the nut, even in confined quarters. Inside the steel band are eight narrow slots which act as lateral keys, and also to tie the front and back of the nut together, strengthening the thread.

WATER HEATER

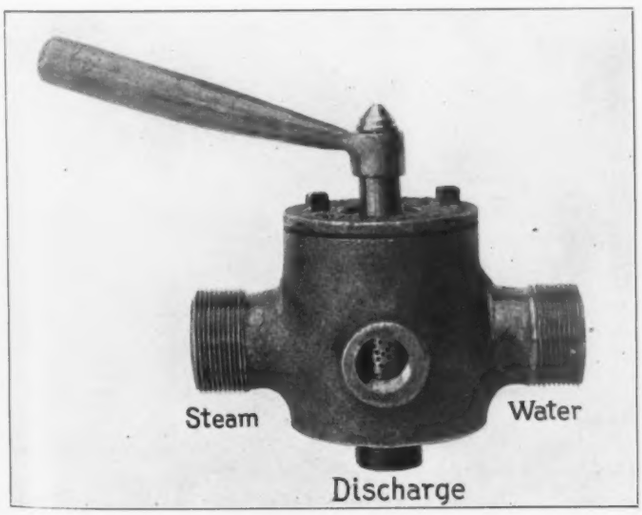
A method of heating cold water at the point of delivery by steam, which is known as the Starwal system, has been placed on the market by Warner-Reiss Sales Company, St. Louis, Mo. The type B valve, which is illustrated, and which handles water in large quantities, may be found of advantage in engine houses for boiler washout work. The amounts of cold water and steam are regulated by separate valves so that any degree of temperature may be readily obtained. The construction of the type B heater is such that no sediment will collect in the valve itself.



Type B Starwal Water Heater

The steam is admitted through a conical step shaped casting perforated with small holes. This casting fits in a conical casting into which the cold water is admitted. The construction is such that any sediment that may collect on the delivery side of either the steam valve or the water valve will be readily washed out through the discharge.

Care should be taken in applying the valve so that the base of the conical casting will be on top. The steam as it comes through the small perforations in the conical casting mixes thoroughly with the water, heating it instantaneously to any



Starwal Heating Valve

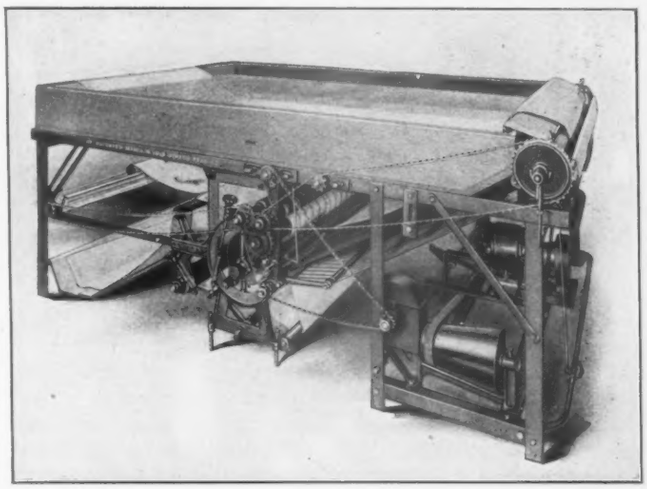
degree of temperature desired. It obviates the necessity of maintaining large reservoirs for hot water. These heaters are made of cast iron and are adapted for all sizes of standard pipes.

One of the illustrations shows the Starwal heating valve, which is operated on the same principle as the Starwal heater. As the steam and water enter the valve they strike baffle plates and become thoroughly mixed. In this valve both the water and steam are controlled by a single handle. The first quarter turn of the handle discharges plain cold water; the second quarter, warm; and the third, hot. The first quarter turn opens the water valve, the second partly opens the steam connection and holds the water valve open, the third partly closes the water valve and opens the steam valve entirely. This valve will be found of advantage in lavatories where hot and cold water are desired for washing purposes. It is also applicable to toilet rooms in cars, where the steam may be taken direct from the steam-heating lines.

MACHINE FOR WASHING, DRYING AND IRONING BLUE PRINTS

The Revolute washing, drying and ironing machine, which is shown in the illustrations, is the result of long study and experimenting to produce a universal machine that will handle not only continuous blue print rolls, but separately cut sheets. The inconvenience of having to keep a machine of this sort continually "threaded" has been borne in mind, and in this design this objectionable feature has been eliminated.

In order to insure the prints being thoroughly washed, which is necessary in order that the chemical reaction may be complete and the prints permanent, a tank has been provided in which the



Revolute Washing and Drying Machine with Tank in Position

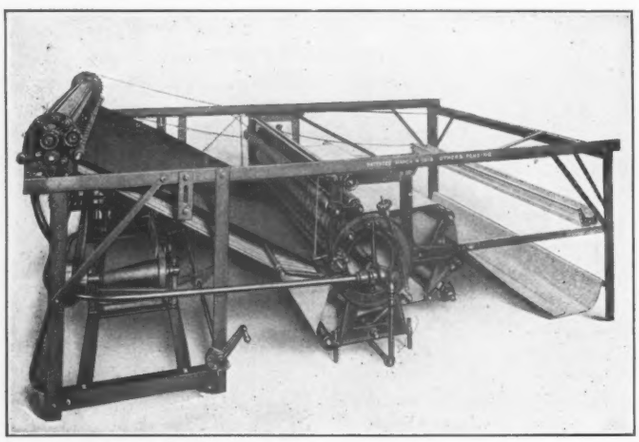
prints may be soaked for any desired length of time. A sufficient quantity may be put into the tank at one time so that some prints may always be ready for drying. When long rolls are being washed they are run through the tank continuously. The surface water is removed mechanically before attempting to dry the print, and the good quality of work is largely, due to the uniformity of the moisture in the print when it goes to the hot drum, and the fact that it is held securely against the hot drum while being dried. The surface of this drum is made absolutely true, insuring the prints being ironed out perfectly flat when delivered from the machine, a feature that is especially valuable in drying vandyke negatives.

The four principal features of the washer and drier are: A tank in which the prints are washed; a wringer which removes the surface water; a hot drum for drying and ironing, and an automatic winding up device for the long prints as they come from the drier. In the operation of the machine, the operator standing in front of the wringer, reaches over it to the tank, lifts the print by the edge, wetting the finger tips only, and lays it on the upper roller of the wringer, which is a 4-in. brass tube accurately ground. The lower roller is a steel shaft covered with felt, which bears against the brass tube, and removes the surface water from the print, at the same time allowing the print always to adhere to the brass roller.

A set of stripping fingers removes the print from the brass

roller and lays it on a set of traveling belts, which carry it to the hot drum, where it passes under a wide canvas belt to the surface of an 8-in. steel drum, accurately ground, and heated by either gas, steam or electricity. During three-quarters of a revolution the paper is held against the drum and dried and ironed. It is then stripped from the drum and deposited in a receiving trough at the end of the machine, or is rolled up in the automatic winding up device if it is a long print. The temperature of the drum and the speed of travel are varied to suit the weight of the paper being dried.

The machine is driven by a motor through a variable speed gear consisting of a belt running on two cones, driving the machine through a worm gear. The speed can be instantly changed by moving the lever. All rollers in the machine carrying any appreciable load are mounted on ball bearings. A foot



Washing and Drying Machine with the Tank Removed

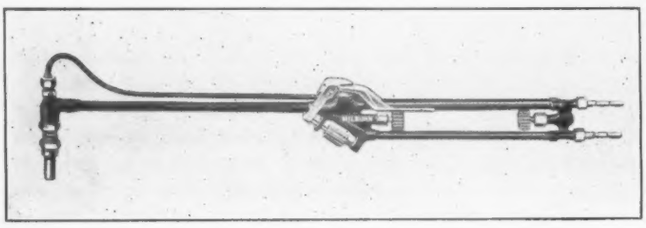
treadle throws the wringer out of gear, and it may then be turned either way by hand in case a print should be started crooked.

This machine is manufactured by the Revolute Machine Company, 417 East 93d street, New York, and will run as a unit with any of that company's blue printers, for continuous printing, washing, drying and ironing. However, this is not recommended, as it is unlikely that the most economical speed of the blue print machine would be also the most economical speed of the washer and drier.

OXY-ACETYLENE WELDING AND CUTTING TORCHES

Improved torches for cutting and welding by the oxy-acetylene process have recently been placed on the market by the Alexander Milburn Company, Baltimore, Md.

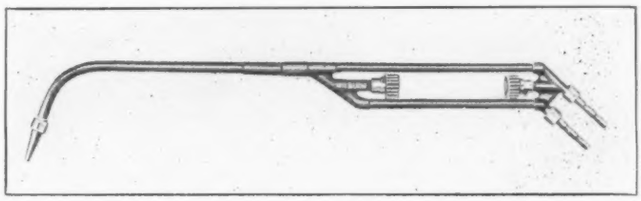
The principal claim made for the welding torch is the provision of a flame that is neither oxidizing nor carbonizing in its



Cutting Torch

action. This is obtained by accurate proportioning and thorough mixing of the gases. To this end, both the oxygen and acetylene are controlled by needle valves within the handle, where they are reached with a slight movement of the operator's fingers and are protected from accidental change through contact with the clothing. The mixing occurs throughout the long chamber leading to the head of the torch, and the two gases are brought to the same pressure and are completely intermixed before the tip is reached. This thorough mixing and special construction of the head minimizes flash-backs.

The cutting torch is designed for cutting operations only. The gases for the pre-heating flame are governed by needle valves, and are mixed in the same way as in the welding torch. The high pressure oxygen for the cutting jet is controlled through the lever on the handle, which operates against a diaphragm



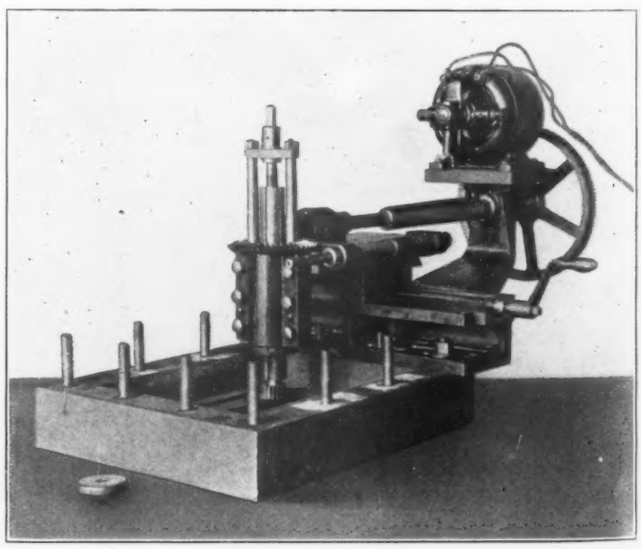
Welding Torch

valve. The gas pressure on the diaphragm normally holds the line open, leaving the operator's hand free. Pressure of the thumb on the lever cuts off the flow temporarily when required. A slight movement of the locking screw locks the lever in the closed position when it is desired to lay the torch down. The employment of a diaphragm eliminates the necessity of a stuffing box in the high pressure oxygen valve, and the attendant necessity of using a lubricant, which is a source of trouble with oxygen.

PORTABLE MILLING MACHINE

A portable milling machine of substantial construction and provided with means for driving by motor, belt or hand, has recently been brought out by the Pedrick Tool & Machine Company, Philadelphia, Pa.

In order to introduce as little complication as possible, there



Portable Milling Machine

are no automatic feeds on the No. 1 machine, hand adjustment for the longitudinal and cross travels being provided. The No. 2 machine, which is considerably larger and is intended for a wider scope of work, has automatic feeds.

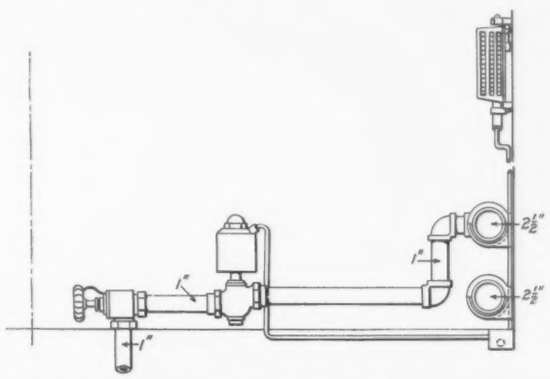
The bed has rib supports in the center and removable posts at both ends. These posts are made to take out, if necessary, when setting up the machine so as not to interfere with a wrench

when tightening holding nuts inside the base. In the base are numerous elongated slots to permit attachment of the machine to the work. An important element of the design is the fact that the machine will mill a surface level with that to which it is attached or several inches below, as in the case of a pump valve seat. When the cutter being used is no larger than the diameter of the spindle, it may be lifted out of the bearing with the spindle, and the cutter sharpened or a new one put on. This is accomplished by loosening two nuts. The spindle has a standard taper so that commercial cutters may be used. The telescopic drive shaft is made amply strong to withstand any work for which the machine is intended. The No. 1 machine will face a surface up to 12 in. by 8 in. and the spindle has a vertical adjustment of 6 in. Direct motor drive is arranged as shown in the engraving.

Besides the use of the machine for milling valve seats in pumps and engines, valve port edges, pads on large frames or housings, it may also be used for making keyways in shafts. While not particularly designed for the purpose, the machine may also be used for drilling.

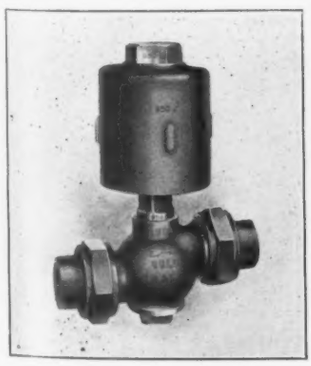
ELECTRIC THERMOSTATIC CONTROL OF STEAM HEATING

A system of automatically controlling the temperature in a passenger train car from the inside has been developed by the Gold Car Heating and Lighting Company, 17 Battery Place, New York, and is known as electric thermostatic control. It

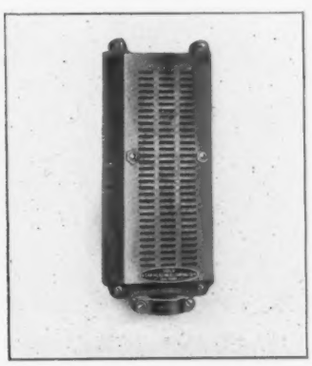


Application of Electric Thermostatic Control to a Passenger Train Car

is claimed that the apparatus will practically hold the temperature in the car constant. The system includes two special devices, an electric thermostat operating contacts by the expan-



Electro-Magnetic Valve

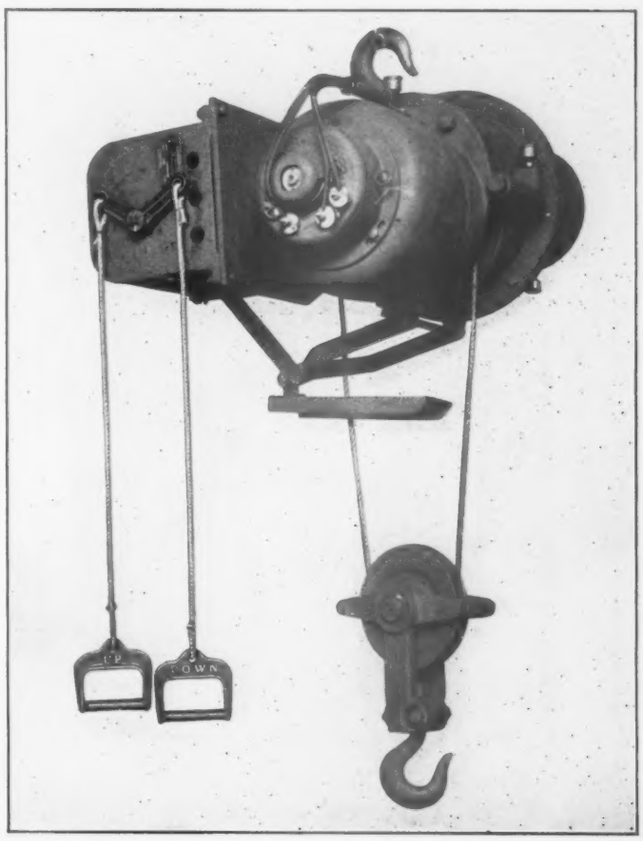


Electric Thermostat

sion and contraction of a temperature-sensitive diaphragm and an electro-magnetic valve. The lowering in the car temperature by changes in the weather causes the thermostat to open the valve and the warming of the car will operate to close the valve. The thermostat is usually placed in a convenient location on the wall near the middle of the car and the electro-magnetic valves are placed in the cross-over pipes on each side of the car underneath a seat, the three being connected by electric wires conveniently placed. The electro-magnetic valve is normally open. The electric current is very small and is obtained from the electric lighting circuit. It is claimed that there is a considerable saving in steam accomplished by the use of this system, either in connection with straight steam or with plain vapor systems. It is said that in the heating of cars in terminal yards tests have shown a saving of from 50 per cent to 75 per cent.

PORTABLE ELECTRIC HOIST

A portable electric hoist which has been developed by the Northern Engineering Works, Detroit, Mich., is shown in the accompanying illustration. Every means has been taken to make the moving parts of the hoist as light as consistent with its capacity. Efforts have also been made to keep the number of parts as small as possible, in order to provide a hoist of simple construction and easy maintenance. All forms of planetary, or worm or bevel gear combinations have been avoided,



Northern Type D Portable Electric Hoist

and standard cut spur gears are used throughout the transmission.

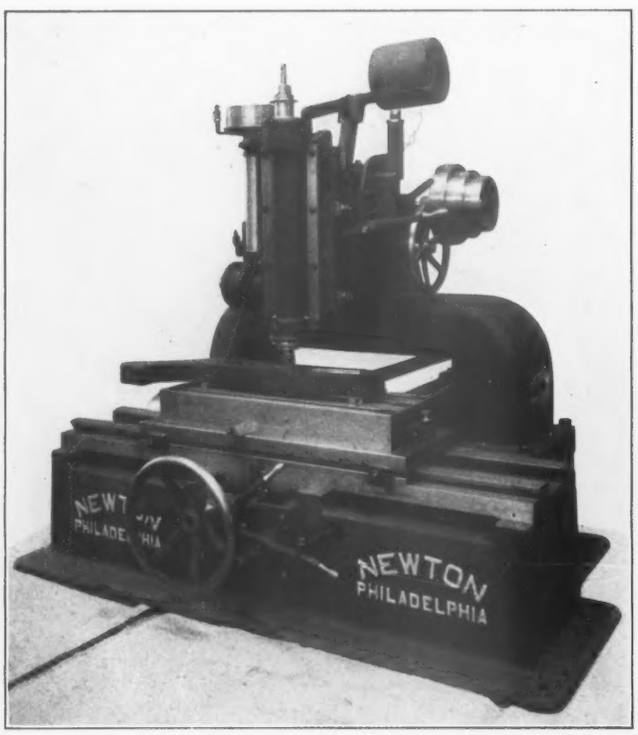
The hoist is suspended by a single hook, and may be used at any place where a hand hoist would be used. It occupies but little more space than a hand hoist and has a speed many times greater. All the gears are enclosed completely for internal lubrication, and the mechanical disc brake is used. Bronze bushings are used throughout and all the gears are heat treated and hardenend forged steel. A smooth-faced drum with wide spool flanges is employed instead of the grooved

drums, which eliminates the cutting of the rope due to the tipping of the hoist. Either alternating or direct current motors may be used, and the controllers may be furnished with or without a graduated speed resistance controller. In the construction of these hoists the interchangeability of the parts has been made a careful study. The standard sizes of the type D electric hoist, shown in the illustration, range from 1,000 to 12,000 lb. capacity. This hoist may also be attached to any standard trolley.

LINK GRINDING MACHINE

The 11,000 lb. link grinder shown in the engraving was designed and built by the Newton Machine Tool Works, Inc., Philadelphia. The links are located on the fixture mounted on the table. The radius is gaged from the center of the link to the center of a pivot at the rear of the machine and is measured by a scale. The maximum capacity is a link of 100 in. radius and of an approximate length of 42 in. To insure central location of the work table while changing the radius for the various size links, pins mounted on both ends are temporarily inserted in hardened steel bushings in the cross slide.

After the machine is started, the hand operated clutch con-



Link Grinding Machine of Substantial Construction

trolling the reciprocation of the saddle is engaged, and the main saddle is then lowered by means of a hand wheel until the emery wheel is in the proper relative position to the face to be ground. During this operation the main saddle feed is made inoperative through a latch lever holding the feed operating clutch neutral.

When the small diameter narrow face wheels are used, the reciprocation clutch and the neutral feed latch are disengaged and the constant feed to the main saddle is operative. Motion for this feed is taken from a cone on the main driving shaft and through a double train of bevel gears to give reverse motion. The length of feed is controlled by trips which are so arranged that the direction of movement of the saddle is automatically reversed. To avoid undue dwell at the end of the stroke a spring roller latch is employed.

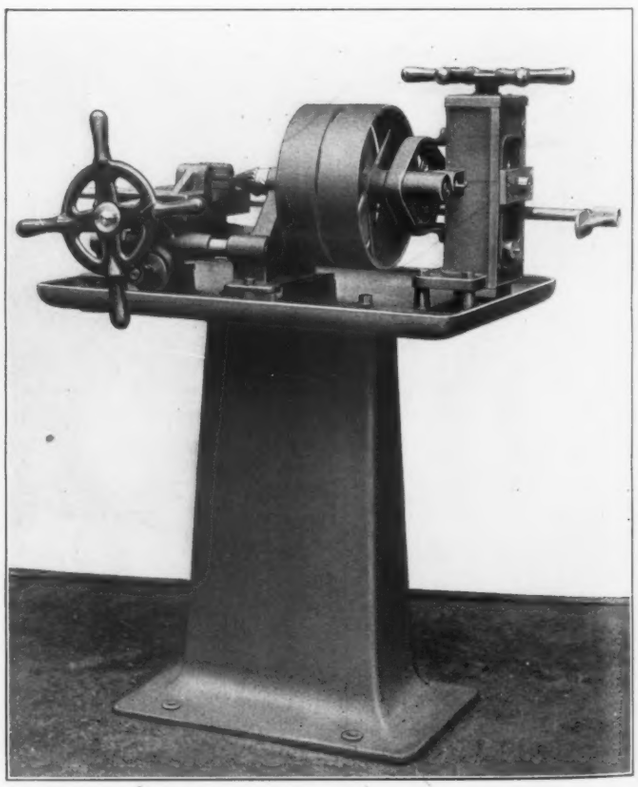
After locating the grinding wheels the trips on the cross slide are adjusted for the length of the travel. These engage a pawl, the action of which is quickened by a spring roller latch to reverse the direction of travel. A lever permits of stopping the table at any desired point, and another lever controls the neutral latch for the table mechanism. The hand wheel shown at the bottom of the machine controls the in-and-out adjustment of the bottom saddle for the depth of cut. This also provides hand cross motion of the slide.

To permit the work table to follow the radius being ground, a table clamp is pivoted to the cross slide. As the radius bar is attached directly to the other slide, adjustments for depth of cut and from side to side of the link are made without disturbing the radius and parallel radii may be ground without resetting the work.

The spindle of the machine varies from 2⅛ in. to 2¼ in. in diameter, and is supported on self-centering ball and taper roller bearings with take-ups, which eliminates wear of the spindle. The spindle speeds range up to 5,000 revolutions per minute. On account of the difference in weight of the saddles the connecting of the one weight to each of these has been made through a horizontal compensating link.

CUTTING OFF AND REAMING MACHINE FOR PIPE AND TUBES

A machine for cutting off and reaming all sizes of pipe and tubes up to 2 in. has recently been developed by the Oster Manufacturing Company, Cleveland, Ohio. This machine is provided with a large single wheel tube cutter which is stationary and is mounted on a steel pinion resting in a bronze bearer. The pipe to be cut off rests on a pair of rollers and by



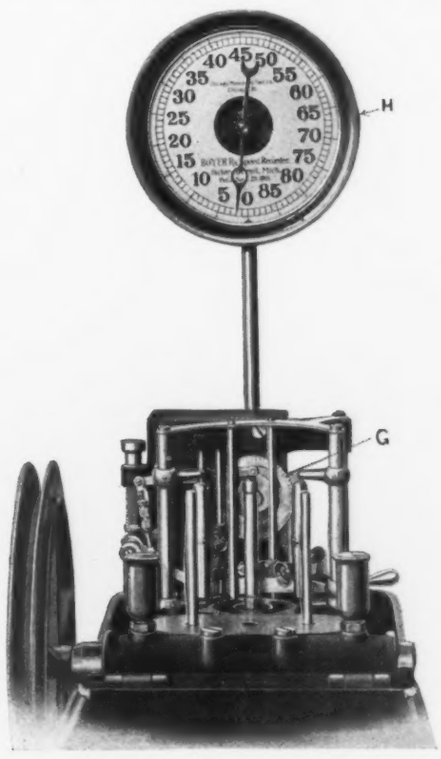
Oster Cutting Off and Reaming Machine for Pipe and Tubes

a turn of the hand wheel at the top of the machine is brought in contact with the cutting disc. The speed of cutting off is regulated by a slight pressure on the hand wheel. The rollers which support the pipe rest on the bottom of a yoke which slides up and down in the frame. The disc cutter can easily be removed

for sharpening or renewal. The gage rod is adjustable for the different lengths of pipe to be cut. In reaming, the pipe is held in the vise jaws shown, which are opened or closed by a movement of the hand wheel at the side of the vise. This open vise facilitates the quick changing of work. The pressure of the pipe against the reamer is brought about by a slight pressure on the handle mounted behind the vise wheel. This handle also moves the vise back and forth. The reamer is held in place by a set screw and can easily be removed for sharpening when necessary.

CLOCK ATTACHMENT FOR BOYER SPEED RECORDERS

An improvement in the present Boyer speed recorder has been made in the shape of a clock attachment by which it is possible to record the time by means of a curve in a manner similar to the recording of the speed. This clock attachment forms a part of the speed recorder itself and is enclosed in the hood that covers the machine. The new speed recorded differs from the original in no way other than in the addition of the dock attachment. The pencil for the time curve is driven by a cam *G*, as shown in the illustration, which makes a complete revolution every hour. The pencil moves vertically and is so adjusted as to travel 1⅞ in. down and 1⅞ in. up for every complete revolution of the cam, or for every hour. This gives a minute space of 1/16 in., and as the chart is ruled by horizontal lines spaced 5/32 in. apart, one line being a heavy line and the other dotted,



Boyer Speed Recorder with Clock Attachment

the distance between the heavy lines represents five minutes. In order to avoid confusing the speed curve with the time curve, the time pencil has been located 1½ in. in advance of the speed pencil.

The accompanying chart is a typical record taken with this new recorder. The mile posts, or the vertical lines, are numbered from 0 to 28, inclusive. The horizontal lines are lettered in this case simply to facilitate the description of the operation of the new recorder, a point on the chart being represented by a letter and figure. The interpretation of this chart is as follows: The engine was in the roundhouse at 4:05 p. m., the clock pencil being at R-6, while the speed pencil was at S-3. The point R-6 was then marked 4-5 p. m. by the inspector, and the top of the recorder was then closed and locked. From the engine house the engine was backed down to its train, a distance of three miles. The time it left the roundhouse is shown by the point L-6, which being three spaces down from R-6 indicates that it was 15 minutes before the engine left the engine house after the inspector had set the time pencil. The engine arrived at the terminal at 4:32½, being 12½ minutes on the road. While at the terminal the time pencil traveled from G-3 to F-3, then to R-3 and back to P-3, indicating that the engine was idle 37½ minutes, and that its leaving time was 5:10 p. m. On pulling out, the speed of the engine was increased in two miles to 40 m. p. h. This speed was maintained but 3½ miles, as there was a slow order between mile posts 6 and 7, on account of which the en-

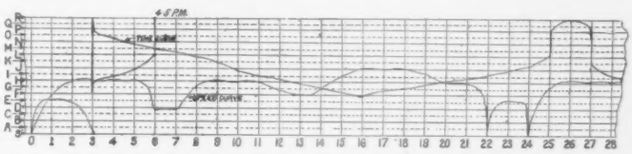


Diagram Made by the Boyer Speed Recorder with Clock Attachment

gineer slowed down to 20 m. p. h., as shown between D-6 and D-7.

The speed was again increased to 40 m. p. h., which speed was maintained until 11 miles out, or at 8:11. A grade of 2½ miles slowed the train down to 30 m. p. h. From the time curve the foot of the grade was reached about 5:27½ p. m. On starting down the other side of the grade the speed was increased until at 16 miles from the terminal 50 m. p. h. was reached. Twenty-one miles out the engineer shut off and coasted, then applied the air, and came to a full stop. The time curve then showed that he was held 10 minutes, as shown by the points L-25 and P-25. The engine was started at 6 p. m. and ran two miles to the station, where a 10 minute stop was made. The station was left at 6:17½ p. m.

With this attachment it is now possible by means of the Boyer speed recorder to record the speed in miles per hour at all points of the trip, the total mileage between any points, the actual running time between points, the total time on the road, the time and location of each stop or slow-down, the time consumed at each stop, and the time and location of each brake application. By means of this device it is possible to tell in detail the movement of a train over a division, and a positive check on the operation of the train is provided.

The Boyer speed recorder is sold by the Chicago Pneumatic Tool Company, Chicago.

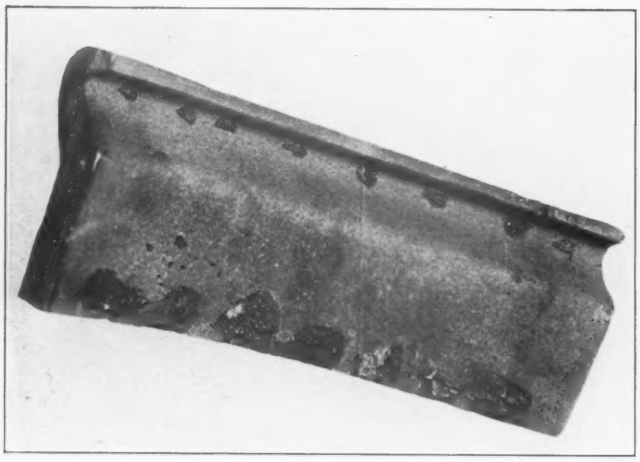
CONSTANT SERVICE WHEEL TRUING BRAKE SHOE

All locomotive and motor driving wheels sooner or later become grooved or form a false flange in service on account of the wear of the tire on the rail. This is especially noticeable on roads where sand is freely used. When the limit of permissible tire wear is reached the wheels must be removed and the tires turned or ground true.

In order to overcome this trouble, a constant service brake shoe, which, it is claimed, trues and keeps true driving wheel tires, has been developed by the American Abrasive Metals Company, New York. Feralun is the material used. The shoe is made with pieces of alundum cast in that portion coming into contact with the wheel tread surface where the false flange usually forms. The balance of the shoe surface in contact with the tire is the usual iron brake shoe mixture. Additional alun-

dum is put in that portion of the shoe bearing on the true flange to prevent its wearing too long. The wear on the tire is not increased; it is merely adjusted to keep the tire free from false flanges. As soon as the false flange in contact with the abrasive material is reduced, the abrading action practically ceases and the wear on the wheel is then, it is claimed, only what it would be with an ordinary shoe.

Alundum now utilized for this purpose in the Feralun shoe is made in electric furnaces and contains no water of crystallization; it, therefore, does not shatter when the hot iron is

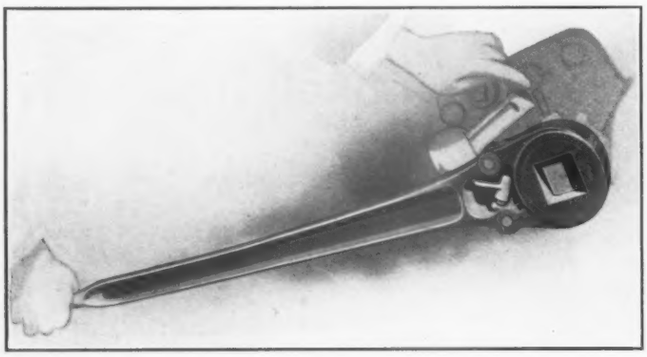


Wheel Truing Brake Shoe

poured over it in the mold. It is also claimed that it is excelled in hardness only by the diamond and is very strong mechanically, and that it overcomes the faults inherent in the minerals heretofore tried and enables the production of a service shoe that will keep wheels true, or make them true if false flanges have already formed. These shoes are now in use on standard and narrow gage locomotives and motors of over 100 railroad and mining companies.

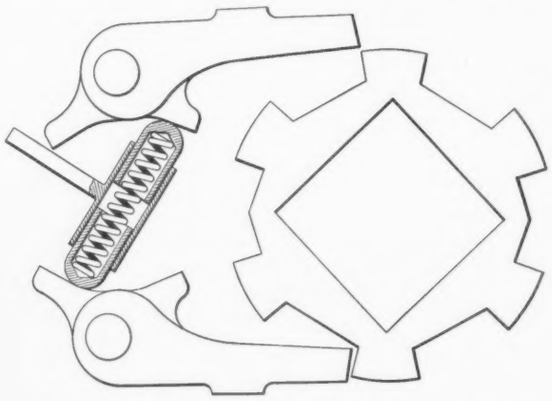
SAFETY WRENCH FOR HOPPER CARS

An automatic safety wrench for opening the doors of hopper, drop bottom or side dump cars is being manufactured by the Hess-Steel Castings Company, Witherspoon building, Philadelphia, and is shown in the illustrations. As will be seen from the line engraving, there are two pawls, either of which can be thrown



Safety Wrench for the Doors of Hopper and Drop Bottom Cars

into or out of engagement, according to whether it is desired to open or close the doors, by means of the reversing attachment. To open the door of a car the wrench is placed on the square end of the hopper shaft and the small handle of the reversing device set upward. The upper pawl is then pushed into engagement with the ratchet, by the thumb, and at the same time the handle is raised to hold it so. The wrench is then lifted until the pressure is taken off the car dog. With the wrench held firmly in this position the car dog is then lifted while the wrench is lowered quickly. This latter operation causes the upper pawl to spring out automatically, allowing the door to drop. In case the door sticks, it can be forced open by raising the handle



Arrangement of the Working Parts of the Safety Wrench

engaging the lower pawl and then forcing the handle of the wrench down. In closing the door, the small handle of the reversing device is set downward, throwing the upper pawl into engagement. The door is then closed by means of the ratchet.

ASBESTOS CARLINING

An asbestos carlining is being furnished by the Franklin Manufacturing Company, Franklin, Pa., for the insulation of steel passenger train cars. This is composed of asbestos fiber made up in standard size sheets, and besides being fireproof it is claimed that it is vermin proof and will not disintegrate and shake down from the sides of the car. It is light in weight and easily applied. One large railway now using the material is applying it by using a common car paint, thickly mixed, to which is added a small quantity of iron oxide. One coat of this is applied to the material and one to the steel sheet, gluing the carlining to the sheet firmly. It is also stated that this lining is an excellent non-conductor and that repeated tests have shown the insulation qualities to be high.

American Locomotives for Australia.—The government of the commonwealth of Australia has recently placed an order for four locomotives for the Transcontinental Railway, now under construction, with the Baldwin Locomotive Works. Such action caused serious debate in the Federal Parliament. The Assistant Minister of Home Affairs has therefore issued the following statement: Every manufacturer of engines in Australia was approached, to ascertain if they could be supplied in Australia. Without exception, the firms replied that they could not give speedy delivery. He then decided to invite quotations for quick supply from over-sea firms. The Baldwin Company of America, made the most satisfactory offer. The price of the Clyde Engineering Company for engines of this type was $30,148, but these American engines were costing $23,573 at Port Augusta, or $25,305 at Kalgoorlie; the question of price, however, did not enter into the case. The need for speedy delivery is that for every 50 miles of track laid an engine is required, and the tracklayers are putting down 1½ miles a day, so that a locomotive is required at each end of the railway every 2½ months. Inquiries were made of over-sea firms doing business in Australia, and the representatives of Baldwin's offered to ship the engines from the United States in 15 weeks. British and Scottish firms wanted 11 or 12 months.

NEWS DEPARTMENT

The Erie Railroad has announced that beginning April 15, its Ohio division will operate on eastern standard time instead of central standard time, as at present.

The shops of the International & Great Northern at Palestine, Texas, have been closed, with the exception of the car department, for an indefinite period.

The coach shops of the Oregon Short Line at Ogden, Utah, were closed indefinitely on April 1. Seventy-five men had been employed at these shops. Some of the work heretofore done at Ogden will be transferred to the shops at Pocatello, Idaho.

R. E. Trevithick, grandson of Richard Trevithick, the inventor of the first locomotive to run on rails, has been in this country for the past few months making a tour of inspection of American railroads. Mr. Trevithick has recently completed a course at the Crewe works of the London & Northwestern. He is the son of A. R. Trevithick, superintendent of the wagon department of the London & Northwestern at the Earlstown works, Crewe, Eng.

SPECIAL TRAIN TO ATLANTIC CITY CONVENTIONS

The "Master Car Builders Special," via the Pennsylvania Lines, will leave Chicago, Union station, at 3 p. m., Monday, June 8, reaching Atlantic City about 2 o'clock the following afternoon. This train will be composed of Pullman, electric lighted, steel cars—library, smoking, sleeping and compartment observation cars, with Pennsylvania diners serving table d'hote dinner leaving Chicago, and a la carte breakfast and luncheon the following day.

The summer tourist fare from Chicago to Atlantic City will be $29.50 for the round trip, good to return within 30 days. Those who desire to go to New York after the convention can purchase summer tourist tickets from Chicago to that point for $30, good to return within 30 days and deposit them for stop-over of 10 days at Philadelphia, purchasing round trip tickets for $2.50, Philadelphia to Atlantic City and return. The date of deposit counts as one day. Those desiring to return via Baltimore and Washington can do so, obtaining stop-over of 10 days at those points, Harrisburg and Pittsburgh, not exceeding the final limit of the ticket, by so specifying at the time of purchasing tickets and by depositing them at stop-over points immediately on arrival, date of deposit to count as one day.

Accommodations can now be reserved at the city ticket office of the Pennsylvania Lines, 242 South Clark street, Chicago, and will be held until June 1, by which time they must be claimed, or by letter to E. K. Bixby, district passenger agent, Pennsylvania Company, Chicago.

MEETINGS AND CONVENTIONS

May Conventions.—The Air Brake Association; the Railway Storekeepers' Association; the International Railway Fuel Association and the Master Boiler Makers' Association hold their annual conventions during May. The place and date of meeting and the subjects to be considered by each of these associations are given in this issue.

Air Brake Association.—The twenty-first annual convention of the Air Brake Association will be held at the Hotel Pontchartrain, Detroit, Mich., May 5-8, 1914. The subjects are as follows: Electro-Pneumatic Signal System for Passenger Trains, by L. N. Armstrong; Air Hose, by T. W. Dow; Clasp Type of Foundation Brake Gear for Heavy Passenger Equipment Cars, by T. L. Burton; Air Gage and Conductor's Valve in Caboose Cars, by Mark Purcell; Analysis of the Factors Involved in Controlling and Stopping Passenger Trains, by Walter V. Turner; 100 Per Cent. Efficiency of Freight Train Brakes, by Fred von Bergen; Recommended Practice, S. G. Down, committee chairman; Topical Subjects, Mountain Grade Work, by H. H. Forney, and Modern Train Building, by George W. Nolan. Among the entertainment features of the convention will be a "Manufacturers' Exploitation Meeting." One afternoon will be set aside for the members to assemble in the convention hall, where each exhibitor will be given from 15 to 30 minutes in which to exploit, by discourse, charts or lantern slides, or in any manner he chooses, the product or device which he desires to place before the assemblage. The executive committee inaugurates this convention novelty, believing that it will assist the booth exhibits, and also give the members an orderly account of what the exhibitors are contributing to the air brake art.

Railway Storekeepers' Association.—At the eleventh annual convention of the Railway Storekeepers' Association, to be held at Washington, D. C., in the Hotel Raleigh, Monday, Tuesday and Wednesday, May 18, 19 and 20, 1914, the following will be the official program:

MONDAY, MAY 18

9 A. M.—Enrollment, convention hall.

10 A. M.—Convention called to order. Invocation by the bishop of Washington, the Right Reverend Alfred Harding; address of welcome, Oliver P. Newman, commissioner of the District of Columbia; address, the president of the association; address, Fairfax Harrison, president, Southern Railway; report of the secretary-treasurer; report of the accounting committee.

12:00.—Adjournment.

1:15 P. M.—Auto busses will be in readiness at the hotel entrance to take members of the convention to the White House, where they will be received promptly at 2 by the President of the United States.

2:30 P. M.—Convention picture in front of the White House; as soon as the picture is taken busses will convey the members back to the hotel.

3:00 P. M.—Convention session; subject K-1, Stores Department Expenses, E. L. Fries; report, Tinware Committee; report, committee on Book of Standard Rules.

5:30 P. M.—Adjournment.

8:00 P. M.—Convention session. Ladies attending the convention will be taken to the Congressional library; meet in convention hall.

10 P. M.—Adjournment.

TUESDAY, MAY 19

9 A. M.—Convention called to order; continuation of report of committee on Book of Standard Rules; subject K-3, Handling of Stationery, S. G. Pettit; report, Piece Work Committee.

9:30 A.M.—Auto trip to the principal buildings and statues in the city for the ladies of the convention.

12:30 P. M.—Adjournment.

2:00 P. M.—Auto busses will leave for steamer to Mt. Vernon.

2:30 P. M.—Steamer leaves pier, foot of Seventh street.

3:40 P. M.—Arrive Mt. Vernon. The president of the association will place a wreath on the tomb of General George Washington.

5:00 P. M.—Steamer leaves Mt. Vernon.

5:15 P. M.—Arrive Marshall Hall, Md., where a genuine Potomac river supper will be served in the dining hall. The hall will accommodate 200, so it will be necessary to have two

tables, the first at 6 o'clock, the second at 7; dancing in the dancing pavilion.

7:45 P. M.—Steamer sails for a trip on the river, arriving in Washington about 10:00 p. m. Auto busses will meet the steamer at the pier and take members of the convention to the Hotel Raleigh. This trip is under the auspices of the Chamber of Commerce of Washington. It will be necessary that members wear their badges, as the badges will be the sole means of identification.

WEDNESDAY MAY 20

9 A. M.—Convention called to order; report, committee on Recommended Practices; report, Scrap Committee; subject K-2, How to Obtain the Greatest Efficiency from Employees in the Stores Department, E. J. Roth and W. D. Stokes; report, committee on Standard Buildings; report, committee on Couplers and Parts; report, Membership Committee; subject K-4, Classification of Electric Railway Materials; committee on Resolutions; election of officers; adjournment.

International Railway Fuel Association.—The sixth annual meeting of this association will be held at Hotel La Salle, Chicago, Ill., May 18 to 21, 1914. The executive committee has selected a list of subjects upon which papers are being prepared that should be of mutual interest to representatives of coal companies and railroad companies. The subjects are as follows: Storage of Coal—Its Feasibility and Advantages to Producer, Carrier and Consumer; Sizing of Coal for Locomotive Use; A Uniform Method of Computing Locomotive Fuel Consumption for Office Statistics and Trip Performance; Honeycombing and Clinker Formation; Coal Space and Adjuncts of Locomotive Tenders; Relation of Front End Design and Air Openings of Grates and Ash Pans to Fuel Consumption and Sparks; Economies in Roundhouse and Terminal Fuel Consumption; Pre-heating of Feed Water for Locomotive Boilers.

Master Boiler Makers' Association.—The eighth annual convention of the Master Boiler Makers' Association will be held at the Hotel Walton, Philadelphia, Pa., May 25, 26, 27 and 28. Committee reports will be presented on the following subjects: Advantage or Disadvantage of Oxy-acetylene and Electric Processes for Boiler Maintenance and Repairs, F. A. Griffin, chairman; What Benefit Has Been Derived from Treating Feed Water for Locomotive Boilers Chemically?, T. F. Powers, chairman; What Can the Association Do to Get a Uniform Rule Regarding the Load Allowed on Staybolts and Boiler Braces?, C. P. Patrick, chairman; Advantages or Disadvantages of Flexible Staybolts to Be Used in Crown Sheets to Take the Place of Sling Stays, C. E. Steward, chairman; Advantage or Disadvantage of Combustion Chambers in Large Mallet or Pacific Type Engines, Other Than a Shorter Flue, A. N. Lucas, chairman; What Shape and Size of Head of Radial Staybolt in Crown Sheet of Oil Burning Engines Gives the Most Efficient Service?, C. L. Hempel, chairman; Does the Method of Flue Cleaning or Rattling Have Any Effect on the Further Scaling Up of Flues?, B. F. Sarver, chairman; Combustion and Fuel Economy, C. F. Petsinger, chairman; Proper Inspection of a Boiler While in Service, C. E. Fourness, chairman; Law, W. H. Laughridge, chairman. The first day of the convention will be taken up by addresses and the general business of the association. The committee reports will be taken up the second day, and on the third day the members will visit the plants of the Parkesburg Iron & Steel Company and the Lukens Iron & Steel Company. Two addresses will be made and the unfinished business taken up on the last day, when the annual dinner will also be held.

Niagara Frontier Car Men's Association.—The Niagara Frontier Car Men's Association was organized at Buffalo, N. Y., March 26, 1914. The objects of the association are to bring together those interested in car department matters for the purpose of exchanging ideas and discussing questions of interest, with the object of facilitating the movement of cars and educating the car man to a keener knowledge of economy in maintenance of equipment. Meetings will be held once a month at Buffalo, N. Y., at which time papers of interest and benefit to the members will be presented. The first meeting will be held May 18 at Conley's Hall, 646-662 Main street, Buffalo, when G. J. Charlton, general foreman car department Delaware, Lackawanna & Western, will present a paper on the "Proper Method of Packing and Lubricating Journals." The officers of the association are as follows: President, W. H. Sitterly, general car inspector Pennsylvania Railroad; first vice-president, W. B. Shone, special inspector New York Central & Hudson River; second vice-president, John McCormick, foreman Lehigh Valley; treasurer, G. J. Charlton, general foreman car department Delaware, Lackawanna & Western; secretary, E. Frankenberger, Pennsylvania Railroad, 623 Brisbane building, Buffalo, N. Y.

The following list gives names of secretaries, dates of next or regular meetings, and places of meeting of mechanical associations.

Air Brake Association.—F. M. Nellis, 53 State St., Boston, Mass. Convention, May 5-8, 1914, Detroit, Mich.

American Railway Master Mechanics' Assoc.—J. W. Taylor, Karpen building, Chicago. Convention, June 15-17, 1914, Atlantic City, N. J.

American Railway Tool Foremen's Association.—A. R. Davis, Central of Georgia, Macon, Ga. Convention, July 20-22, 1914, Hotel Sherman, Chicago.

American Society for Testing Materials.—Prof. E. Marburg, University of Pennsylvania, Philadelphia, Pa. Convention, June 30-July 4, Hotel Traymore, Atlantic City, N. J.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Convention, June 16-19, St. Paul-Minneapolis, Minn.

Car Foremen's Association of Chicago.—Aaron Kline, 841 North Fiftieth Court, Chicago; 2d Monday in month, except July and August, Lytton building, Chicago.

Chief Interchange Car Inspectors' and Car Foremen's Association.—S. Skidmore, 946 Richmond street, Cincinnati, Ohio. Convention, August 25-27, 1914, Cincinnati, Ohio.

International Railway Fuel Association.—C. G. Hall, 922 McCormick building, Chicago. Convention, May 18-22, 1914, Chicago.

International Railway General Foremen's Association.—William Hall, 829 W. Broadway, Winona, Minn. Convention, July 14-17, 1914, Hotel Sherman, Chicago.

International Railroad Master Blacksmiths' Association.—A. L. Woodworth, Lima, Ohio. Convention, August 18-20, 1914, Milwaukee, Wis.

Master Boiler Makers' Association.—Harry D. Vought, 95 Liberty St., New York. Convention, May 25-28, 1914, Hotel Walton, Philadelphia, Pa.

Master Car Builders' Association.—J. W. Taylor, Karpen building, Chicago. Convention, June 10-12, 1914, Atlantic City, N. J.

Master Car and Locomotive Painters' Assoc. of U. S. and Canada.—A. P. Dane, B. & M., Reading, Mass. Convention, September 8-11, 1914, Nashville, Tenn.

Niagara Frontier Car Men's Association.—E. Frankenberger, 623 Brisbane building, Buffalo, N. Y. Meetings monthly; next meeting, May 18, 1914, 646 Main St., Buffalo.

Railway Storekeepers' Association.—J. P. Murphy, Box C, Collinwood, Ohio. Convention, May 18-20, 1914, Hotel Raleigh, Washington, D. C.

Traveling Engineers' Association.—W. O. Thompson, N. Y. C. & H. R., East Buffalo, N. Y. Convention, August, 1914, Chicago, Ill.

RAILROAD CLUB MEETINGS

Club	Next Meeting	Title of Paper	Author	Secretary	Address
Canadian	May 12	Annual Meeting, Election of Officers		Jas. Powell	Room 13, Windsor Hotel, Montreal.
Central	May 8	Forestry and Forest Fire Fighting	W. G. Howard and W. F. Goltra	H. D. Vought	95 Liberty St., New York.
New England	May 12	Steam Turbines	Elmer Smith	Wm. Cade, Jr.	683 Atlantic Ave., Boston, Mass.
New York	May 15	Bureau Inspection by Railroads	Wm. F. Zimmerman	H. D. Vought	95 Liberty St., New York.
Pittsburgh	May 22	Ill Effects of Boiler Feed Waters	W. A. Converce	J. B. Anderson	207 Penn. Station, Pittsburgh, Pa.
Richmond				F. O. Robinson	C. & O. Ry., Richmond, Va.
St. Louis	May 8	The Railroads and the People	Pat Nelson	B. W. Frauenthal	Union Station, St. Louis, Mo.
Southern & S'w'r				A. J. Merrill	218 Grant Bldg., Atlanta, Ga.
Western	May 19	Annual Meeting		Jos. W. Taylor	1112 Karpen Bldg., Chicago, Ill.

PERSONALS

It is our desire to make these columns cover as completely as possible all the changes that take place in the mechanical departments of the railways of this country, and we shall greatly appreciate any assistance that our readers may give us in helping to bring this about.

GENERAL

WILBUR D. ARTER has been appointed supervisor of apprentices of the New York Central & Hudson River, with headquarters at New York, succeeding Henry Gardner, resigned.

E. G. CROMWELL has been appointed motive power inspector of the Baltimore & Ohio, with headquarters at Baltimore, Md.

C. A. GILL has been appointed assistant district superintendent of motive power of the Baltimore & Ohio, at Baltimore, Md., succeeding J. W. G. Brewer, resigned.

W. H. MALONE has been appointed assistant superintendent of locomotive performance of the St. Louis & San Francisco, with headquarters at Springfield, Mo.

D. J. MULLEN, assistant to the superintendent of motive power of the Cleveland, Cincinnati, Chicago & St. Louis, has been appointed superintendent of motive power, with headquarters at Indianapolis, Ind., succeeding S. K. Dickerson, resigned.

F. K. MURPHY has been appointed assistant to the superintendent of motive power of the Cleveland, Cincinnati, Chicago & St. Louis, with headquarters at Indianapolis, Ind., succeeding D. J. Mullen, promoted.

W. E. RICKETSON, who has been appointed mechanical engineer of the Cleveland, Cincinnati, Chicago & St. Louis, with headquarters at Beech Grove, Ind., as announced in the April issue, was graduated from Cornell University in 1907, with the degree of M. E. He began railway work in 1903 with the Delaware & Hudson Company, for which company he worked during his summer vacations while attending college. From 1907 to 1910 he was special apprentice with the Lake Shore & Michigan Southern, and the following two years successively was roundhouse foreman of the Lake Erie, Alliance & Wheeling at Alliance, Ohio, and the Lake Shore & Michigan Southern at Ashtabula. He was then general foreman of the latter road at Youngstown, Ohio, until September, 1913, when he was appointed assistant mechanical engineer of the Cleveland, Cincinnati, Chicago & St. Louis, which position he held at the time of his promotion to mechanical engineer.

P. O. WOOD has been appointed superintendent of locomotive performance of the St. Louis & San Francisco, with headquarters at Springfield, Mo., succeeding Robt. Collett, resigned.

MASTER MECHANICS AND ROAD FOREMEN OF ENGINES

MARK BAER has been appointed master mechanic of the Colorado, Kansas & Oklahoma, with headquarters at Scott City, Kan.

CHARLES F. BARNHILL, whose appointment as division master mechanic of the Gulf, Colorado & Santa Fe, with headquarters at Silsbee, Tex., was announced in the April issue, was born December 26, 1872, at McArthur, Ohio. He was educated in the common schools, and began railway work in October, 1886, with the Ohio Southern, as a machinist apprentice at Springfield, Ohio. After completing his apprenticeship in November, 1891, he was employed as machinist at the Lagonda shop at Springfield for seven months, when he went to the Chesapeake & Ohio as machinist at Clifton Forge, Va. From February, 1893, to November, 1898, he was successively machine foreman, erecting foreman and general foreman at Clifton Forge, and the following two years was erecting foreman at Huntington, W. Va. In November, 1900, he went to the Columbus, Shawnee & Hocking as machinist at Columbus, Ohio, and from July, 1901, to December, 1902, was machine and erecting foreman at that place. Mr. Barnhill then became connected with the Gulf, Colorado & Santa Fe as erecting foreman at Cleburne, Tex. In May, 1904, he was made roundhouse foreman at that point, and in March, 1907, was promoted to division foreman at Gainesville, Tex., which position he held at the time of his appointment as master mechanic of the Beaumont division on March 1, as above noted.

H. BOOTH has been appointed road foreman of engines of the Delaware & Hudson Company, with headquarters at Carbondale, Pa.

J. COOLS has been appointed supervisor of locomotive operation of the Erie Railroad, with headquarters at Jersey City, N. J.

J. CUNNEEN has been appointed supervisor of locomotive operation of the Erie Railroad, with headquarters at Jersey City, N. J.

J. W. HIGHLEYMAN has been appointed assistant master mechanic of the Union Pacific, with headquarters at Cheyenne, Wyo.

M. S. MONTGOMERY has been appointed road foreman of engines of the Northern Pacific, with headquarters at Duluth, Minn.

JAMES ROBERTS has been appointed master mechanic of the Union Pacific, with headquarters at Kansas City, Mo.

W. SINNOTT has been appointed master mechanic of the Baltimore & Ohio, with headquarters at East Side, Philadelphia, Pa.

M. K. TATE has been appointed master mechanic of the Cleveland, Cincinnati, Chicago & St. Louis at Beech Grove, Ind.

CAR DEPARTMENT

P. W. HELWIG, general car foreman of the Minneapolis & St. Louis, at Minneapolis, Minn., has been appointed master car builder of the Chicago & Alton, with headquarters at Bloomington, Ill., succeeding T. M. Ramsdell, resigned.

B. F. LILLY has been appointed general foreman of the car department of the St. Louis, Brownsville & Mexico, with headquarters at Kingsville, Tex., succeeding W. L. Jones, resigned.

H. MACK has been appointed general foreman, car department of the Atchison, Topeka & Santa Fe, at Bakersfield, Cal.

J. O'NEAL has been appointed master car builder of the New Orleans, Mobile & Chicago, with headquarters at Mobile, Ala.

L. C. ORD has been appointed assistant master car builder of the Canadian Pacific, Eastern lines, with office at Montreal, Que., succeeding P. A. Crysler, assigned to other duties.

A. H. SWEETMAN has been appointed car foreman of the Canadian Northern, at North Battleford, Sask.

SHOP AND ENGINE HOUSE

F. CLARKE has been appointed locomotive foreman of the Canadian Northern at Calgary, Alta.

CHARLES E. COPP has been appointed foreman of the paint shop of the Billerica, Mass., shops of the Boston & Maine.

B. D. DEHN has been appointed general foreman of the Boston & Maine at Boston, Mass.

E. E. EVANS has been appointed general foreman of shops of the Erie Railroad at Cleveland, Ohio, succeeding J. J. Good, resigned.

J. FIFE has been appointed locomotive foreman of the Great Northern at Casselton, N. D.

CHARLES FITZGERALD has been appointed roundhouse foreman of the Erie Railroad at Cleveland Ohio, succeeding E. E. Evans.

HENRY GARDNER, supervisor of apprentices of the New York Central & Hudson River, has been appointed assistant superintendent of shops of the Baltimore & Ohio at Mt. Clare, Baltimore, Md. Mr. Gardner was born at Salem, Mass., in 1872, and educated in the grammar and high schools and at Massachusetts Institute of Technology in Boston, receiving the degree of mechanical engineer. From 1896 to 1899 he was superintendent of apprentices of the Boston & Maine at Boston, and from 1899 to 1904 he was with the same road at Concord, N. H., as shop draftsman, shop inspector and assistant master mechanic. He was then for one year erecting foreman of the American Locomotive Company at the Pittsburgh Works, and one year with the H. K. Porter Company, Pittsburgh. From 1906 to 1908 he was chief draftsman and apprentice instructor of the Pittsburgh & Lake Erie, and from 1908 to 1912 he was assistant supervisor of apprentices of the New York Central Lines at New York. In 1912 he was appointed supervisor of apprentices of the New York Central & Hudson River, the position he leaves to go with the Baltimore & Ohio as assistant superintendent of shops.

E. C. HANSE has been appointed general foreman of the Atlanta, Birmingham & Atlantic at Talladega, Ala.

M. E. MARTZ has been appointed general foreman of the locomotive department of the Baltimore & Ohio at Somerset, Pa.

EMIL MARX has been appointed general foreman of the Chicago & North Western at Winona, Minn.

C. L. MEGALIS has been appointed general foreman of the Atlanta, Birmingham & Atlantic at Fitzgerald, Ga.

J. K. MILHOLLAND has been appointed general foreman of the locomotive department of the Baltimore & Ohio at Grafton, W. Va.

FRANK REVANA has been appointed erecting shop foreman of the Erie Railroad at Cleveland, Ohio, succeeding T. V. Peterson.

C. W. RHINEHARD has been appointed general foreman of the Atlanta, Birmingham & Atlantic at Brunswick, Ga.

C. W. ROBERTSON has been appointed general foreman of locomotive repairs of the Chicago, Burlington & Quincy at Aurora, Ill.

C. E. TEST has been appointed general foreman of the Chicago Great Western at Council Bluffs, Iowa.

H. THOMPSON has been appointed locomotive foreman of the Canadian Northern Ontario at Parry Sound, Ont., succeeding J. Quinn.

F. S. TORBACK has been appointed general foreman of the locomotive department at the Mount Clare shops of the Baltimore & Ohio at Baltimore, Md.

C. B. VAN BLARCUM has been appointed general foreman of the locomotive department of the Baltimore & Ohio at Columbus, Ohio.

PURCHASING AND STOREKEEPING

D. L. DONALDSON has been appointed storekeeper of the Baltimore & Ohio at Parkersburg, W. Va., succeeding J. D. Burke, resigned.

G. W. HAYDEN has been appointed assistant to the chief purchasing agent of the St. Louis & San Francisco, with headquarters at St. Louis, Mo.

W. P. HICKEY has been appointed division storekeeper of the New York Central at Oswego, N. Y., succeeding J. F. Wallace.

H. P. McQUILKIN has been appointed district storekeeper of the Baltimore & Ohio at Cincinnati, Ohio.

F. A. MURPHY has been appointed district storekeeper of the Baltimore & Ohio at Wheeling, W. Va.

E. J. ROTH, assistant general storekeeper of the Chicago, Burlington & Quincy at Chicago, has been appointed supply agent of the Chicago, Indianapolis & Louisville, with headquarters at Lafayette, Ind.

E. W. THORNLEY has been appointed district storekeeper of the Baltimore & Ohio at Glenwood, Pa.

L. H. TUTWILER, traveling storekeeper of the Baltimore & Ohio system, with office at Baltimore, Md., has been appointed district storekeeper, with headquarters at Mount Clare shops, Baltimore, Md.

OBITUARY

WILLIAM APPS, formerly master car builder of the Algoma Central & Hudson Bay, died at his home in Toronto, Ont., March 21, aged 67 years. Mr. Apps was also master car builder of the Canadian Pacific from 1895 to 1902.

WILLIAM O'HERIN, assistant to the general manager of the Missouri, Kansas & Texas System, with headquarters at Dallas, Tex., died at the Mercy hospital, Chicago, March 31, aged 69 years. He had been connected with the Missouri, Kansas & Texas for 40 years, beginning as a locomotive fireman. He was later locomotive engineer, and subsequently became master mechanic. He was promoted to superintendent of machinery and equipment in 1897, which position he held until January 1, 1913, when he was made assistant to the general manager.

JOHN R. SKINNER, superintendent of stores of the Delaware & Hudson Company at Oneonta, N. Y., died suddenly on April 6 at his home in that city.

CYRUS WARMAN, for some time past a press agent or publicity adviser of the Grand Trunk at Montreal, died at Chicago April 7 at the age of 68. Mr. Warman was born in Illinois and began railroad work on the Denver & Rio Grande in 1880, working first as a wiper, and later as locomotive fireman and then engineman. At the age of 33, he began to do a little newspaper work in Colorado, and from a small beginning he soon became a popular poet and story writer; and as "Cy Warman" he is widely known in the literary world. He was one of the first, if not the very first, of American railroad men to make a success as a writer of stories of railroad life. He was the first writer who combined the taste requisite to make a pleasing story with the knowledge of railroad work and the candor as an observer necessary to make his delineations true to life.

NEW SHOPS

CINCINNATI, NEW ORLEANS & TEXAS PACIFIC.—This road is building with its own forces a passenger coach repair and paint shop at Chattanooga, Tenn. The building will be 300 ft. long, and will be provided with four tracks to hold three cars each.

PENNSYLVANIA LINES.—Plans have been completed for new shop buildings to be located at Indiana Harbor, Ind.

WIRELESS LIGHTHOUSES.—Wireless lighthouses are being established by the French government along the north coast, the first two being situated on islands near the approach to the port of Brest. Two more are planned for the port of Havre. The lighthouses will operate by a system almost exactly like that of ordinary lighthouses, except that, instead of waves of light, wireless waves will give the information to approaching ships. The great advantages of such lighthouses is that fog will not hinder their efficiency.—*The Engineer.*

SUPPLY TRADE NOTES

The Union Fibre Company, Winona, Minn., has moved its Chicago office from room 1613 Great Northern building to the Railway Exchange building.

R. C. Cole has joined the staff of the pneumatic tool department of the Ingersoll-Rand Company, New York, and has been stationed at the Chicago office.

The Transportation Utilities Company, New York, has acquired the entire business of the General Railway Supply Company, Chicago, effective April 15, 1914.

The engineering and contracting firm of MacArthur Brothers Company, New York, has moved its Chicago office to 1892 Continental and Commercial Bank Building.

The general offices of the Orenstein-Arthur Koppel Company have been moved from Pittsburgh to Koppel, Pa., in order that they may be in closer touch with the plant.

Muir B. Snow has been elected president and general manager of the Detroit Twist Drill Company, Detroit, Mich., to fill the position formerly occupied by his brother, Neil W. Snow, deceased.

Robert Collett, formerly superintendent of locomotive performance of the St. Louis & San Francisco, has been appointed assistant manager of the railway lubricating department of The Pearce Oil Corporation at St. Louis, Mo.

Walter A. Johnson, formerly of Atlanta, Ga., has been appointed pneumatic tool manager at the Pittsburgh branch of the Ingersoll-Rand Company, New York. C. F. Overly, formerly of Pittsburgh, has been appointed pneumatic tool manager at the Cleveland office.

The general offices of the United States Light & Heating Company will be moved on May 20 from 30 Church street, New York, to the company's plant at Niagara Falls, N. Y. This transfer will bring together in one place the administrative, sales, engineering and production departments.

The Titan Storage Battery Company, Newark, N. J., has been established to take over the business of the Baltimore Storage Battery Company, Baltimore, Md. The new company will continue under the same ownership and management as its predecessor. There will be no change in the policy of the latter beyond that of expansion of operations.

The Standard Steel Castings Company, Cleveland, Ohio, has placed in operation a new shop, 80 ft. by 253 ft., and has installed an additional two-ton convertor, thus increasing the capacity of the plant to 25 tons of castings per day. Thomas B. Lavey, who for the past seven years has been superintendent of the Isaac G. Johnson plant at Spuyten Duyvil, N. Y., has been made superintendent.

Walter Bentley has recently been appointed western representative of the Curtain Supply Company, Chicago. He is a son of H. T. Bentley, superintendent of motive power of the Chicago & North Western, and has had a thorough railway training. Beginning in the stores department, he worked his way through various branches of railway work, having served in different departments of the shops and in the roadmaster's, general superintendent's and purchasing agent's offices. The last two years he has represented the Baldwin Locomotive Works and the Standard Steel Works Company.

Frank N. Grigg, whose appointment as sales agent of the Transportation Utilities Company, New York, for the southeastern and southern district of that company, was announced in the April issue, was born in Richmond, Va., August 9, 1876. He entered the employ of the Chesapeake & Ohio in 1892, and spent ten years in the motive power and stores department of that road. In January, 1903, he became eastern representative of the Adams & Westlake Company, Chicago, and for the past year up to the time of his new appointment he has been district manager of the Standard Heat & Ventilation Company, New York, with office at Washington. Mr. Grigg has his office at room 1201, Virginia Railway & Power building, Richmond. He is also sales agent for the Rostand Manufacturing Company, Milford, Conn.

The announcement is made that the United States Steel Corporation and its subsidiary companies propose to have a comprehensive exhibit of their operations at the Panama-Pacific Exposition in San Francisco in 1915. It will begin with the ore fields, and carry on an educative picture of the operations in ore mining, rail and water transportation, dock operations, coal, coke and pig iron production, steel manufacturing in its various lines, and will also present the processes of manufacturing of many of its subsidiary companies' products, including National pipe; also how it utilizes its by-products and the display of many uses in which its general products are employed, typifying the advancement in the uses of this country's resources. In addition to the material exhibits before mentioned, the corporation intends to exhibit in a comprehensive manner, by moving pictures, its operations throughout all departments showing the ramifications of the processes of the corporation's operations. It is proposed as well to set forth to the world the work which the United States Steel Corporation has done towards the social welfare of its employees and those depending upon them. Also it will exhibit many forms of safety devices that have been conceived by the corporation officials and its employees. In this social welfare department will also be shown the methods employed in the aid and care of the injured.

Frank H. Clark, formerly sales manager of the railroad department of the Watson-Stillman Company, New York, has recently bought the Chambers throttle valve business of that company and established the Chambers Throttle Valve Company with himself as president. Mr. Clark was born in New York on March 8, 1872. He obtained his start in the railway supply business in 1890 when he entered the employ of the Standard Coupler Company, of which his father was president. In 1893 he went south to Atlanta, Ga., to engage in a general railway and mill supply business, and in 1897 in connection therewith opened a machine shop and foundry to which he later added a boiler repair shop. Three years later he sold his business and returned to New York to enter the sales department of the Townsend & Downey Ship Building Company. When this company went out of business in 1903 he became vice-president and treasurer of T. N. Motley & Company, Inc., dealing in railway supplies at New York. He remained with this company about five years and then left to enter the railroad sales department of the Watson-Stillman Company. About three years ago he brought to that company the throttle valve invented by John Chambers, of the Atlantic Coast Line, and has since devoted a very large portion of his time to the development and introduction of that appliance. The office of the new company is at 30 Church street, New York.

F. H. Clark

CATALOGS

Power Hammers.—Beaudry & Company, Inc., 141 Milk street, Boston, Mass., have recently issued a four page leaflet descriptive of the Beaudry Peerless power hammers. These hammers are either belt or motor driven and are made in seven sizes.

Locomotive Cranes.—Bulletin No. 30 from the McMyler Interstate Company, Cleveland, Ohio, is descriptive of that company's type J standard gage locomotive crane. Illustrations are included showing the cranes in use in various capacities.

Drilling Stands.—Bulletin E-31 of March 1, 1914, issued by the Chicago Pneumatic Tool Company, Fisher building, Chicago, is devoted to the Duntley electric sensitive drilling stands. Information is also given concerning electric drills to fit these stands.

Metal Mouldings and Shapes.—This is the subject of a catalog just issued by the Dahlstrom Metallic Door Company, Jamestown, N. Y., manufacturers of cold drawn metal mouldings. The catalog is very complete and shows a large variety of shapes for metal moulding.

Yost Draft Gear.—Pamphlet No. 18, issued by the Hart-Otis Car Company, Ltd., Montreal, Que., describes the Yost draft gear. This is a lever friction draft gear of high capacity and has been in experimental service for several years. It is now in use on a large number of cars in severe service.

Punches and Shears.—Catalog 12 from The Ironton Punch & Shear Company, Ironton, Ohio, illustrates and describes the various machines made by that company, including vertical punches and shears, horizontal punches, universal shears, straightening rolls, bending rolls, multiple punches, gate shears, steam hammers and other tools.

Ball Bearings in Axle Generators.—Bulletin No. 12 of the S. K. F. Ball Bearing Company, 50 Church street, New York, is a 15 page booklet dealing with the use of ball bearings in the axle generators of railway electric lighting equipment. The booklet is well illustrated and contains on the last page, a list of the railways using this type of bearing in axle generators.

Steel Boiler Tubes.—The National Tube Company, Pittsburgh, Pa., has issued a circular entitled About Steel Boiler Tubes, which is based on the report of the International Boilermakers' Association committee on the subject of steel versus iron tubes. The economy claimed for the National steel tube is presented in this circular in the form of a problem in arithmetic.

Foster Locomotive Superheater.—The Power Specialty Company, 111 Broadway, New York, is issuing a catalog devoted to the Foster locomotive superheater. The first installation of this superheater was made on the Pennsylvania Railroad over two years ago. The catalog includes drawings showing the application of the superheater as well as drawings of a number of detail parts.

Safety First in Emery Wheel Work.—The American Emery Wheel Works, Providence, R. I., has recently issued a chart on how to prevent grinding wheel accidents. This chart is so arranged that it may conveniently be hung on a wall. A red disc with the words "Safety First" in white appears in the center. Copies of the chart will be furnished to users of grinding wheels on application.

Flexible Joints.—The Moran Flexible Steam Joint Company, Inc., Louisville, Ky., has issued a catalog showing the various types of flexible connectors for pipe which are manufactured by that company. Illustrations are included showing these joints in use on steam lines in engine houses, as well as in the flexible connections between locomotives and tenders. Patents have been granted on an application to locomotive steam pipes.

The Pitot Tube and Fan Testing.—This is the subject of bulletin No. 35, Series 1, of January, 1914, issued by the American Blower Company, Detroit, Mich. The bulletin contains 32 pages and is issued solely in the interest of standardizing procedure so that fan ratings can be specified in a manner understood by all who have to deal with them. The American Blower Company does not manufacture nor sell the instruments described in the pamphlet.

Steel Pipe.—In some way the Bulletin No. 11B, issued by the National Tube Company, Pittsburgh, Pa., and commented on in this column last month, was headed "Iron Pipe." There was no excuse for this error, as any one who is at all familiar with the products manufactured by the National Tube Company must realize that it has to do only with steel products. In this connection that company has just issued a folder under the title of "Thought It Was Steel—But It Wasn't," which indicates clearly the nature of its product.

German Locomotives.—The February, 1914, number of the Hanomag Journal gives a description of the 7000th locomotive turned out by the Hannoversche Maschinenbau-Actien-Gesellschaft, Hanover, Germany. This locomotive was completed January 30, 1914, and is a ten-wheel freight engine, with superheater, for the Prussian State Railways. The Journal also includes illustrations of the first locomotive turned out at these works and a historical sketch dealing with the mort important locomotives from the first to the 7000th.

Silent Chain Drive.—Book No. 125 issued by the Link-Belt Company, Chicago, contains a great deal of valuable information concerning the application of that company's link-belt silent chain to various kinds of machinery. The book contains 112 pages, and is handsomely gotten up and well illustrated. Among other data it includes a number of tables giving the horsepower transmitted by link-belt chains of various pitches and widths at different speeds. It is possible with this book to select the size of chain and wheel most suitable for any work under consideration.

Forges, Blowers, Exhaust Fans, Etc.—General catalog No. 179 has been issued by the Buffalo Forge Company, Buffalo, N. Y. It is 5 in. by 7½ in. in size, and contains 304 pages. Among the various lines of equipment and tools which are illustrated and described in more or less detail are forges; blowers; exhaust fans; disk fans; drills; punches; shears; bending machines; tire setters; combination woodworking machines; steam engines and turbines; fan system apparatus for heating, ventilating, drying and mechanical draft; air washers; humidifiers and dehumidifiers.

Axle Light.—Bulletin No. 11 from the Consolidated Railway Electric Lighting & Equipment Co., Hanover Bank building, New York, tells of the development of the Consolidated axle light equipment, and in an attractive manner describes fully the various details of the apparatus and the principal advantages which are claimed for it. While no radical changes have been made in the equipment, a number of important improvements have been made in the details. The dynamo has cast handhold covers instead of sheet iron covers, the pole changer has been strengthened and Timken roller bearings have been added.

Street Locomotive Stoker.—Catalog 14, from the Locomotive Stoker Company, Schenectady, N. Y., discusses briefly the advantages of the Street locomotive stoker, and presents general views and important dimensions of a number of locomotives equipped with such stokers on the Baltimore & Ohio, Norfolk & Western, Chesapeake & Ohio, Hocking Valley, Virginian, New York Central Lines, Chicago, Burlington & Quincy, and the Buffalo, Rochester & Pittsburgh. Then follow comments on the effect of the mechanical stoker on tonnage, steam pressure, capacity, speed, train movements, cleaning fires, safety, reliability, labor and the fireman.